CHAPTER 4

Money and Inflation

MACROECONOMICS SIXTH EDITION

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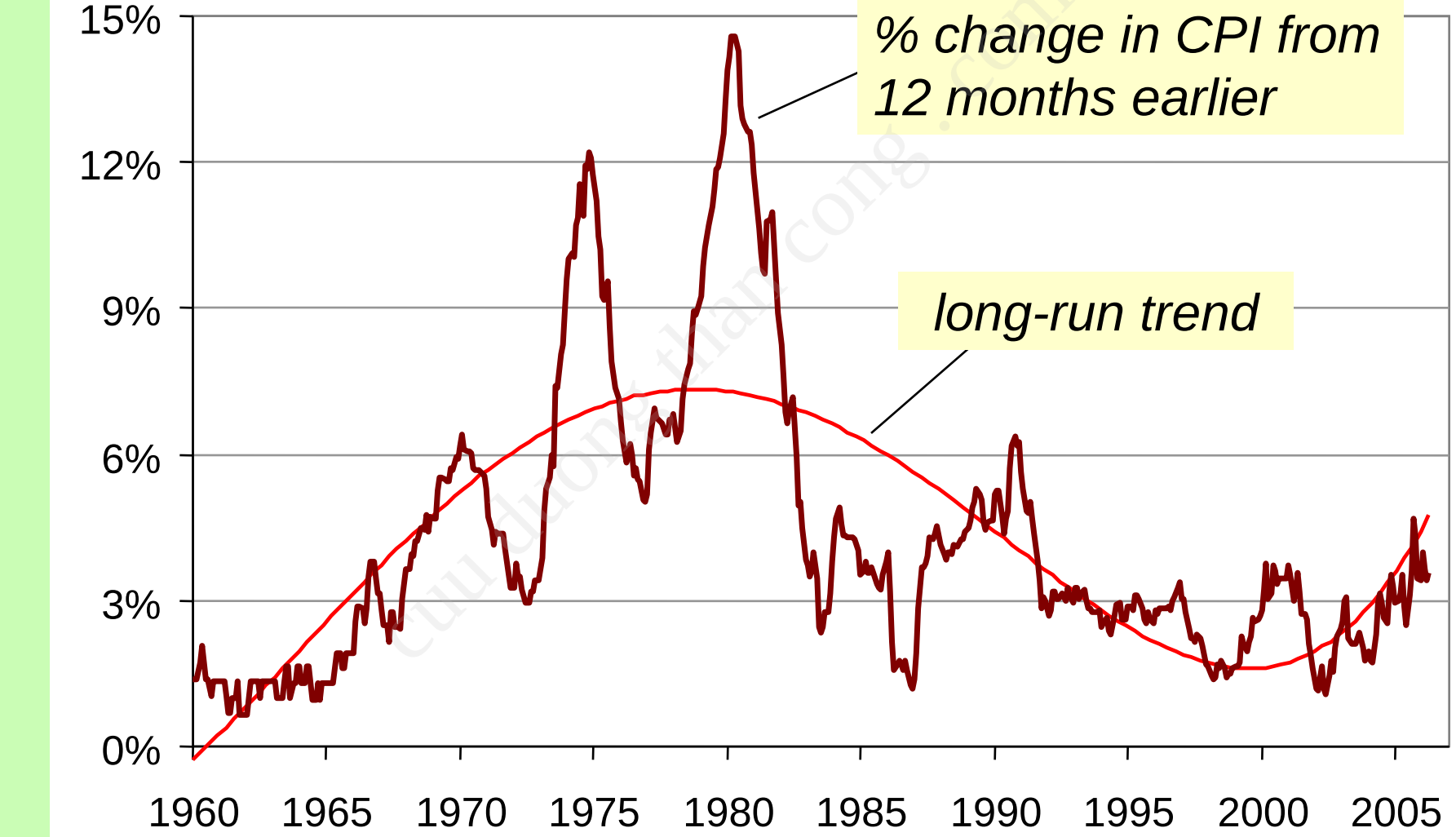
PowerPoint® Slides by Ron Cronovich

In this chapter, you will learn…

- The classical theory of inflation
  - Its causes
  - Its effects
  - Its macroeconomic costs
- It applies in the long run

U.S. inflation and its trend, 1960-2006



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 measured in units 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.

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, April 2006

symbol	assets included	amount ($ billions)
C	Currency	$739
M1	**C** + demand deposits, travelers' checks, other checkable deposits	$1391
M2	**M1** + small time deposits, savings deposits, money market mutual funds, money market deposit accounts	$6799

The Quantity Theory of Money

- Its a simple theory linking the inflation rate to the growth rate of the money supply.
- It 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

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.*

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.

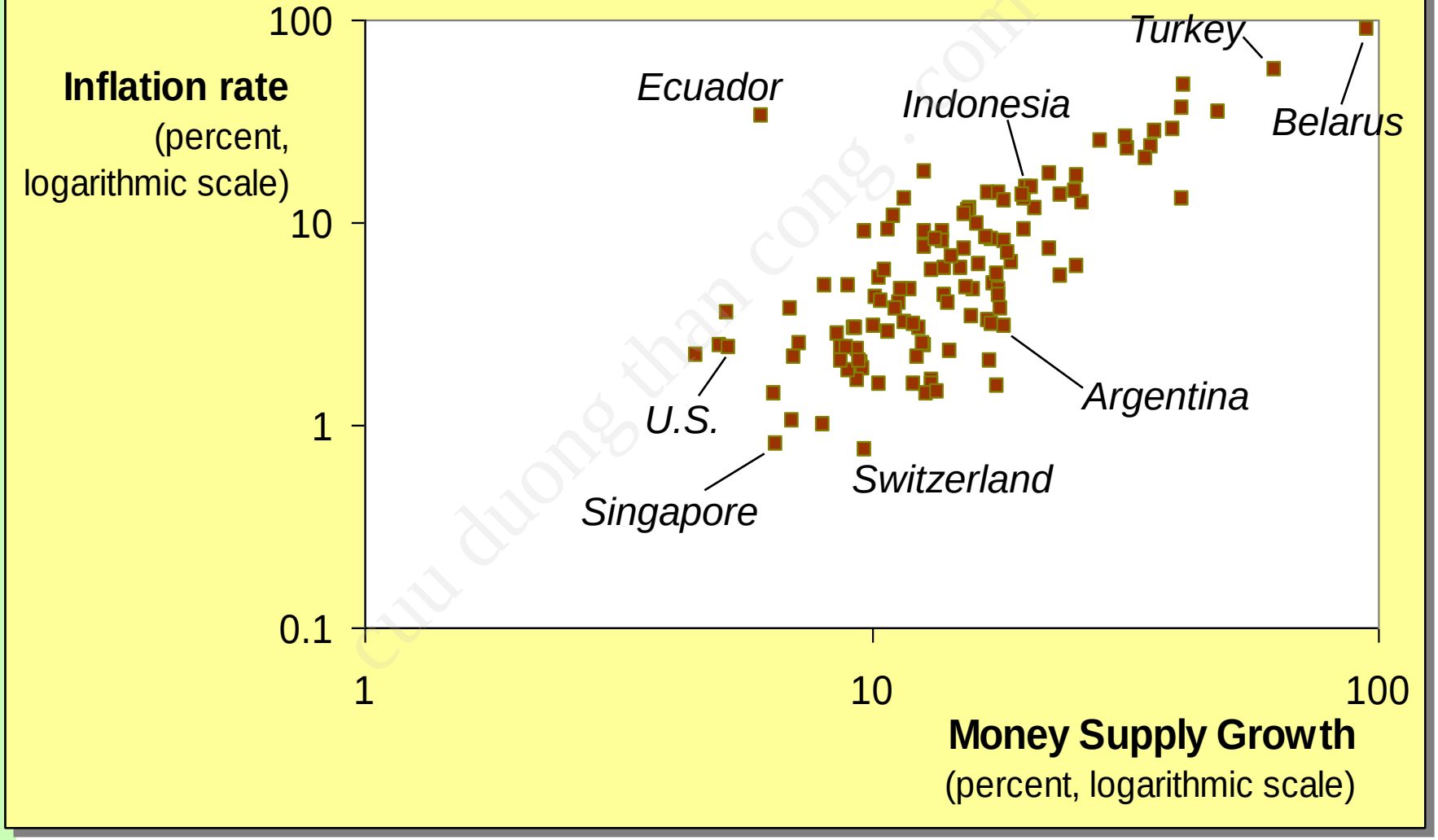
Confronting the quantity theory with data

The quantity theory of money implies

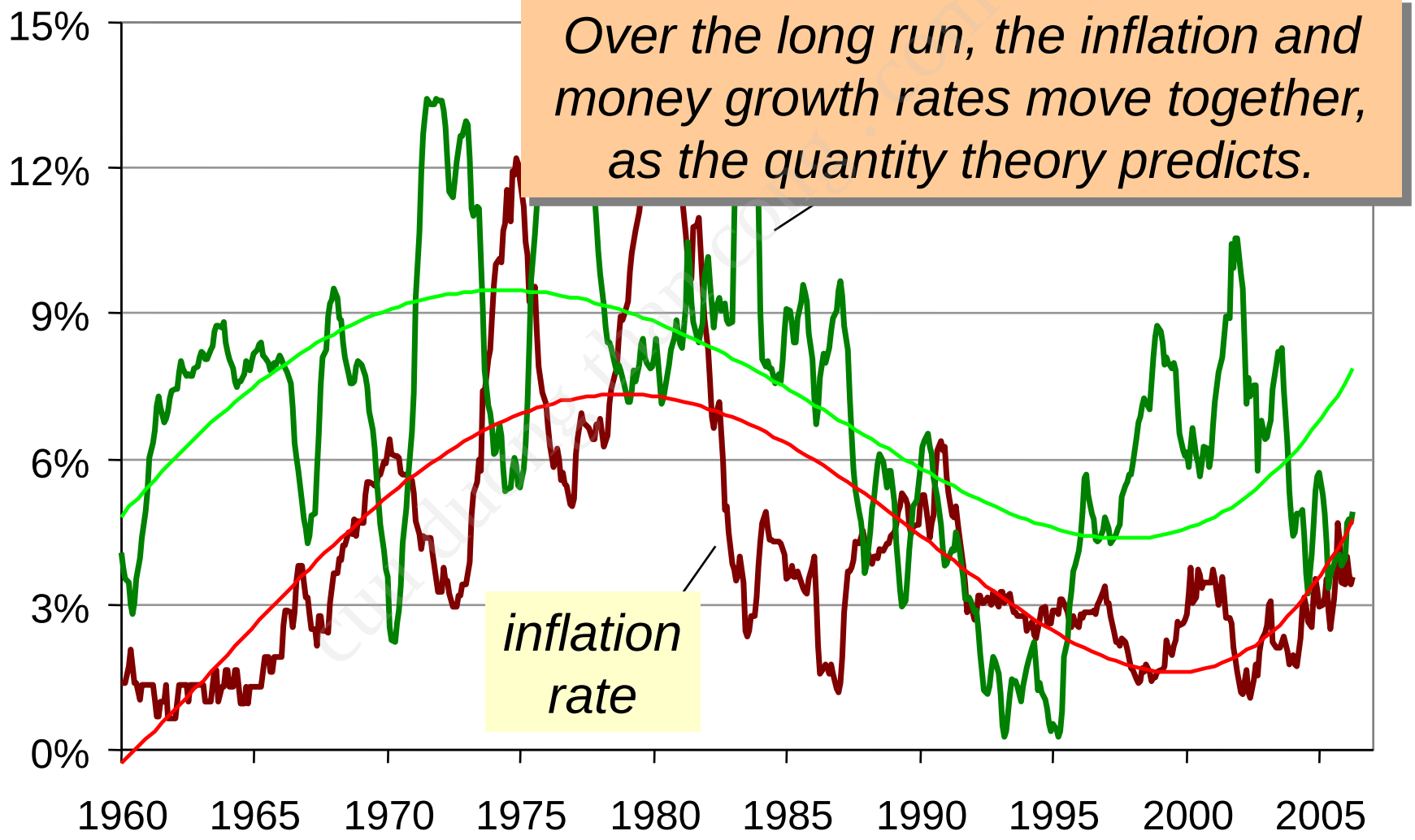
1. countries with higher money growth rates should have higher inflation rates.
2. the long-run trend behavior of a country's inflation should be similar to the long-run trend in the country's money growth rate.

Are the data consistent with these implications?

International data on inflation and money growth



U.S. inflation and money growth, 1960-2006



Inflation and interest rates

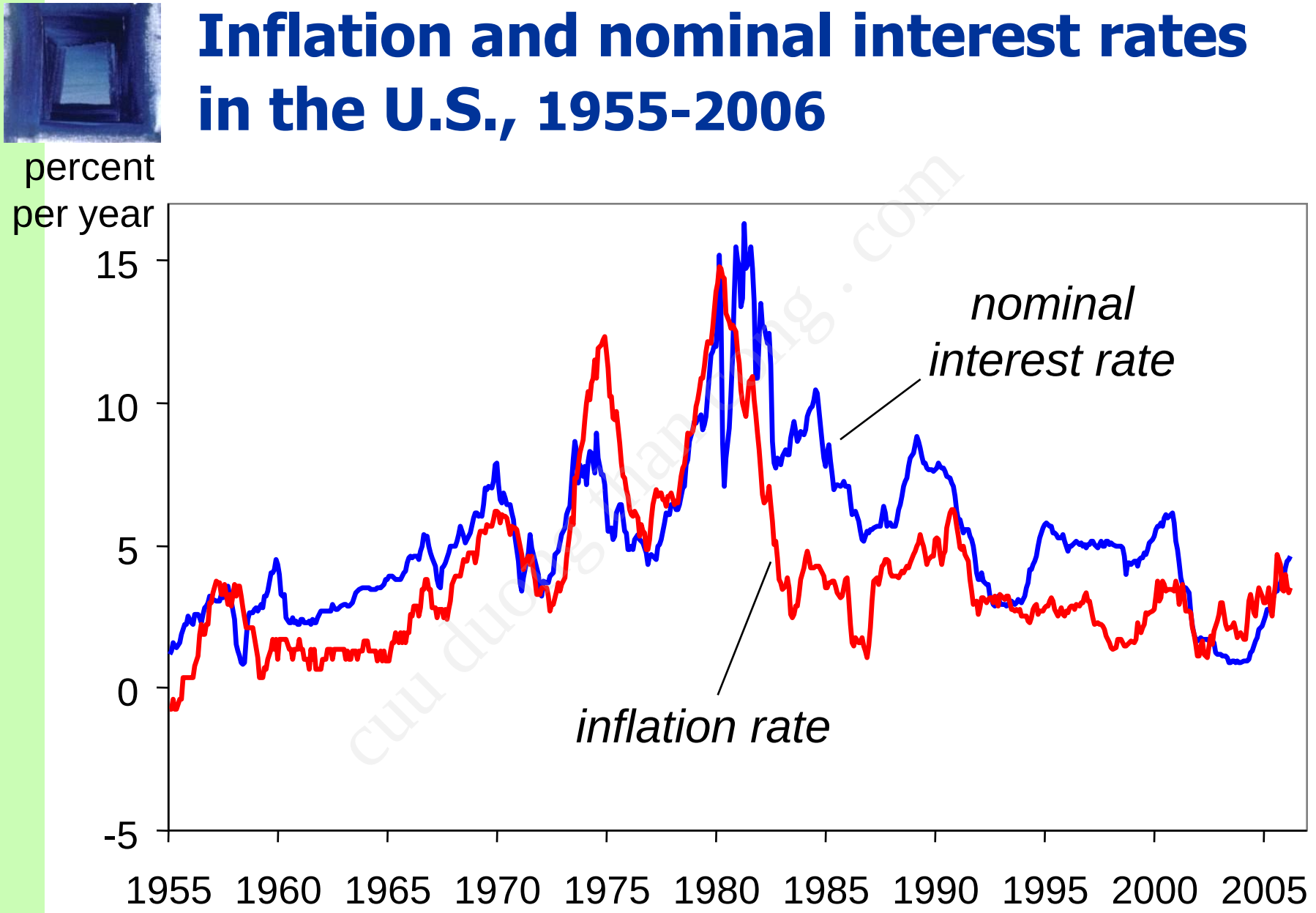
- Nominal interest rate, ***i***
  not adjusted for inflation
- Real interest rate, ***r***
  adjusted for inflation:

$$r = i - \pi$$

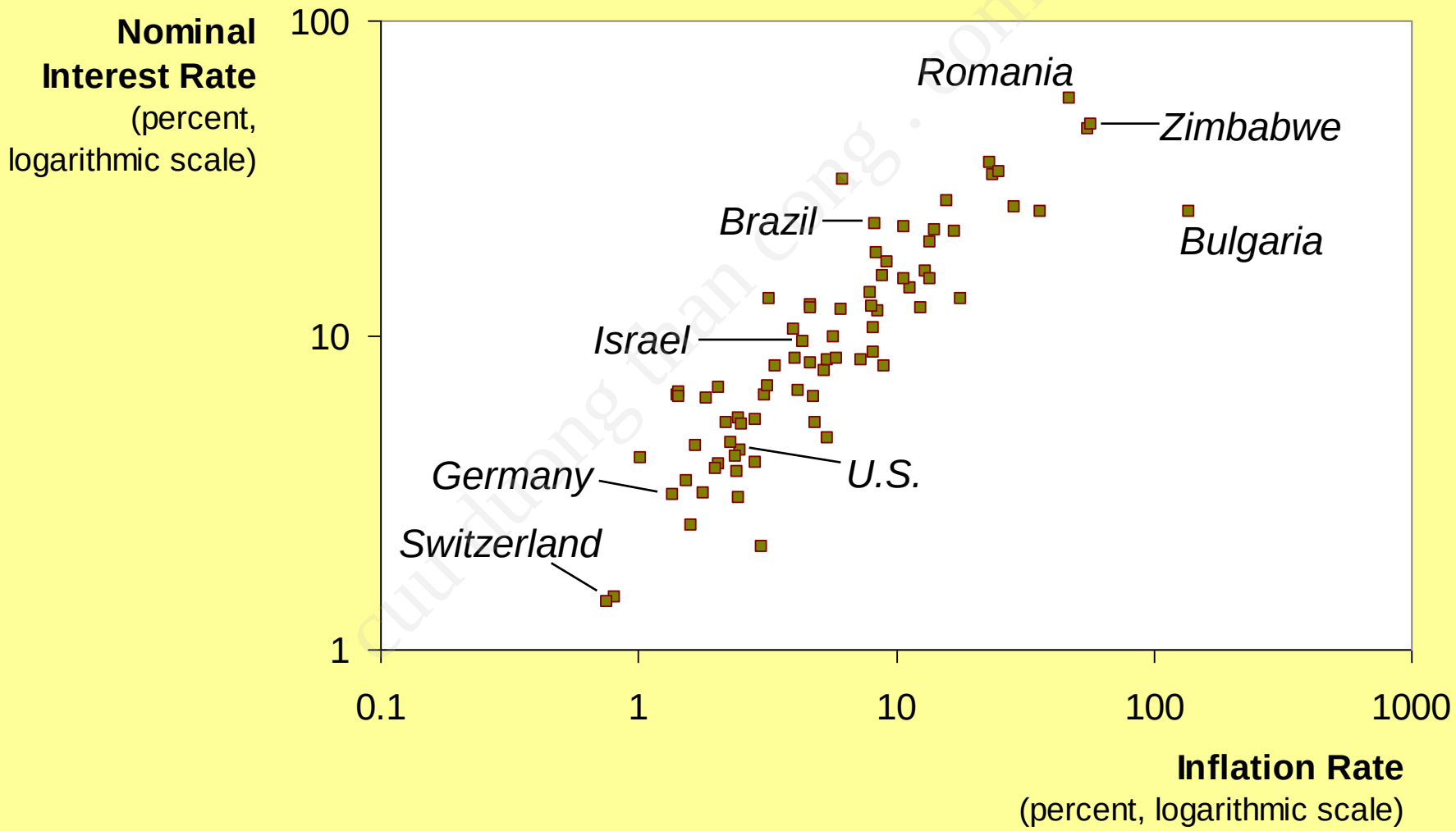
The Fisher effect

- 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., 1955-2006



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.

Two real interest rates

- π = actual inflation rate
  (not known until after it has occurred)
- π^e = expected inflation rate
- $i - \pi^e$ = ***ex ante*** real interest rate:
  the real interest rate people expect
  at the time they buy a bond or take out a loan
- $i - \pi$ = ***ex post*** real interest rate:
  the real interest rate actually realized

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.

Money Demand

$$\frac{M^{d}}{P} = L(i) \times Y$$

- $(M/P)^d$ = real money demand, depends
  - negatively on ***i***. (Because ***i*** is the opportunity cost of holding money)
  - positively on ***Y***

    higher ***Y*** $\Rightarrow$ more spending

    $\Rightarrow$ so, need more money

Money Equilibrium

- Money Demand (Md) = Money Supply (M) in equilibrium. Therefore,

$$\frac{M}{P} = L(i) \times Y$$

Money Equilibrium

- Recall that $i = r + \pi^e$.
- In the long run, expectations are fulfilled on average: $\pi^e = \pi$.
- Therefore, $i = r + \pi$.

$$\frac{M}{P} = L(i) \times Y \longrightarrow \frac{M}{P} = L(r + \pi) \times Y$$

Money Equilibrium

$$\frac{M}{P} = L(r + \pi) \times Y$$

- From page 25 of the textbook …
- Growth rate of *M* – Growth rate of *P* = Growth rate of *L* + Growth rate of *Y*.
- Recall that *r* was determined in Ch. 3. Also, assume that inflation, π, is constant in the long run. Then $i = r + \pi$ is constant. Therefore, *L* is constant. Therefore,
- π = Growth rate of *M* – Growth rate of *Y*, a constant.

Price Level

- Therefore, the long run price level (P) is:

$$P = \frac{M}{L\,(r + \text{Growth rate of } M - \text{Growth rate of } Y) \times Y}$$

- Note that if M increases—without any change in the *growth rate* of M—then P increases by the same proportion.
  - Keep in mind that Y and its growth rate are determined by non-monetary factors discussed in chapter 3.

Price Level

$$P = \frac{M}{L\,(r + \text{Growth rate of } M - \text{Growth rate of } Y) \times Y}$$

- If the growth rate of *M* increases, then so does *P*.
- If either *Y* or its growth rate increases, then *P* decreases.
- If the real interest rate, *r*, increases, then so does *P*.

Inflation

- Recall that
  π = Growth rate of *M* – Growth rate of *Y*
  in the long run.
- Therefore, if either the growth rate of the money supply (*M*) *increases* by, say, 2 percentage points, or if the growth rate of total output (*Y*) *decreases* by the same amount, then the rate of inflation (*π*) will *increase* by the same 2 percentage points.

Monetary Neutrality

- Note that unless there is a change in the real parameters of chapter 3, the real endogenous variables of that chapter will not change.
- In particular, changes in *M* or the growth rate of *M* cannot affect the real variables that were determined in chapter 3, for obvious reasons.

Monetary Neutrality

- However, although *M*/*P* is a real variable, it is affected by changes in the growth rate of *M*.
- Also, changes in real variables such as *Y* and the growth rate of *Y* do have an effect on *P*, although it is a nominal variable.

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

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

The supply of real money balances

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* ,

$$\uparrow \pi^e \Rightarrow \uparrow i \text{ (the Fisher effect)}$$

$$\Rightarrow \downarrow (M/P)^d$$

$$\Rightarrow \uparrow P \text{ to make } (M/P) \text{ fall}$$

to re-establish eq'm

Discussion question

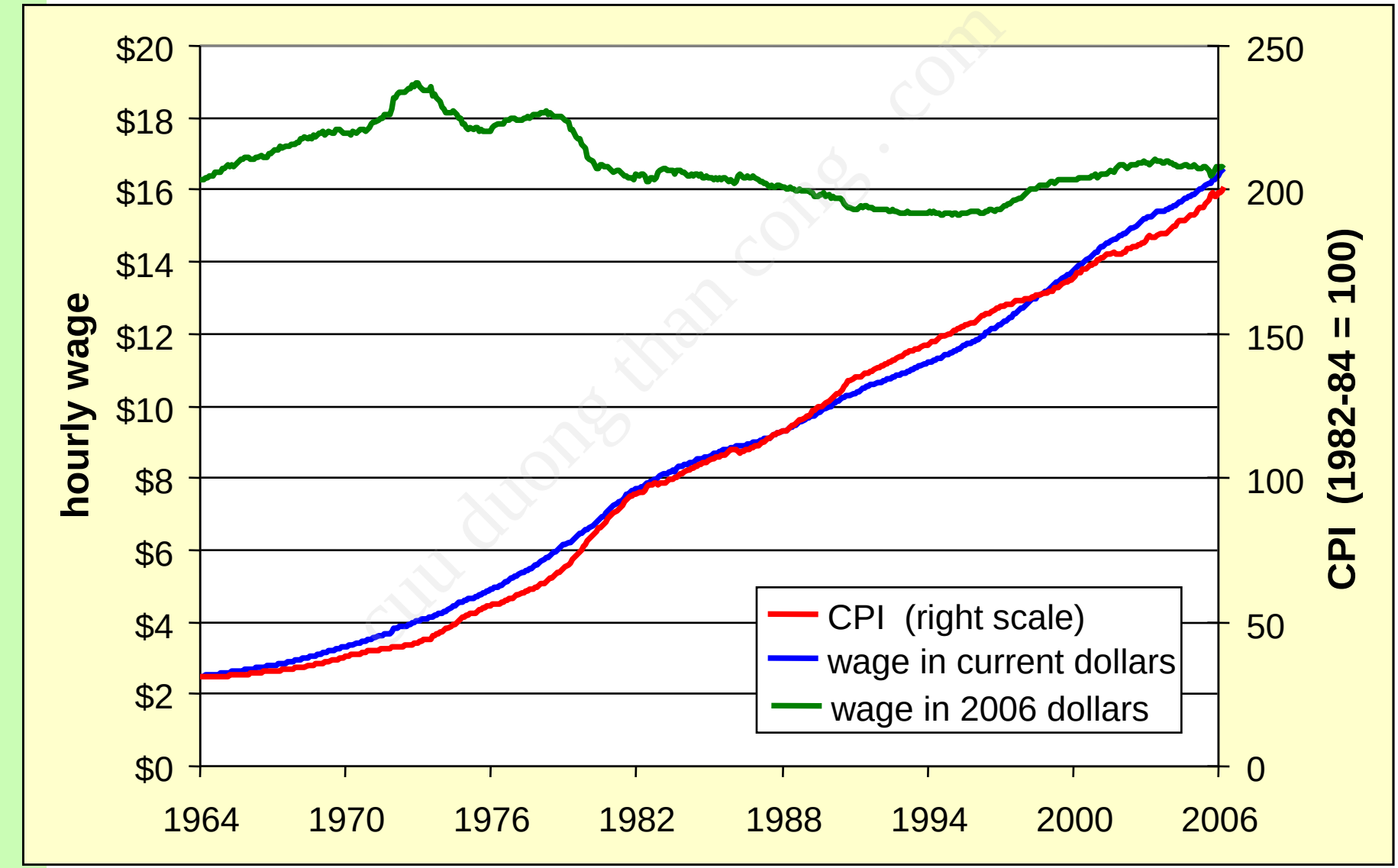
Why is inflation bad?

- What costs does inflation impose on society? List all the ones you can think of.
- Focus on the long run.
- Think like an economist.

A common misperception

- Common misperception:
  inflation reduces real wages
- This is true only in the short run, when nominal wages are fixed by contracts.
- (Chap. 3) In the long run,
  the real wage is determined by
  labor supply and the marginal product of labor,
  not the price level or inflation rate.
- Consider the data…

Average hourly earnings and the CPI, 1964-2006



The classical view of inflation

- *The classical view:*
  A change in the price level is merely a change in the units of measurement.

So why, then, is inflation a social problem?

The social costs of inflation

…fall into two categories:

1. costs when inflation is expected
2. costs when inflation is different than people had expected

The costs of expected inflation: 1. Shoeleather cost

- def: the costs and inconveniences of reducing money balances to avoid the inflation tax.
- $\uparrow \pi \Rightarrow \uparrow i$

  $\Rightarrow \downarrow$ real money balances
- Remember: In long run, inflation does not affect real income or real spending.
- So, same monthly spending but lower average money holdings means more frequent trips to the bank to withdraw smaller amounts of cash.

The costs of expected inflation:
2. Menu costs

- def: The costs of changing prices.
- Examples:
  - cost of printing new menus
  - cost of printing & mailing new catalogs
- The higher is inflation, the more frequently firms must change their prices and incur these costs.

The costs of expected inflation: 3. Relative price distortions

- Firms facing menu costs change prices infrequently.
- Example:
  A firm issues new catalog each January.
  As the general price level rises throughout the year, the firm's relative price will fall.
- Different firms change their prices at different times, leading to relative price distortions…

  …causing microeconomic inefficiencies in the allocation of resources.

The costs of expected inflation:
4. Unfair tax treatment

Some taxes are not adjusted to account for inflation, such as the capital gains tax.

Example:

- Jan 1: you buy $10,000 worth of IBM stock
- Dec 31: you sell the stock for $11,000, so your nominal capital gain is $1000 (10%).
- Suppose $\pi = 10\%$ during the year. Your real capital gain is $0.
- But the govt requires you to pay taxes on your $1000 nominal gain!!

The costs of expected inflation: 5. General inconvenience

- Inflation makes it harder to compare nominal values from different time periods.
- This complicates long-range financial planning.

Additional cost of *unexpected* inflation: Arbitrary redistribution of purchasing power

- Many long-term contracts not indexed, but based on π^e.
- If π turns out different from π^e, then some gain at others' expense.

  Example: borrowers & lenders
  - If $\pi > \pi^e$, then $(i - \pi) < (i - \pi^e)$ and purchasing power is transferred from lenders to borrowers.
  - If $\pi < \pi^e$, then purchasing power is transferred from borrowers to lenders.

Additional cost of high inflation: Increased uncertainty

- When inflation is high, it's more variable and unpredictable:
  π turns out different from π^e more often,
  and the differences tend to be larger
  (though not systematically positive or negative)
- Arbitrary redistributions of wealth become more likely.
- This creates higher uncertainty, making risk averse people worse off.

One benefit of inflation

- Nominal wages are rarely reduced, even when the equilibrium real wage falls.
  This hinders labor market clearing.
- Inflation allows the real wages to reach equilibrium levels without nominal wage cuts.
- Therefore, moderate inflation improves the functioning of labor markets.

Hyperinflation

- def: $\pi \geq 50\%$ per month
- All the costs of moderate inflation described above become *HUGE* under hyperinflation.
- Money ceases to function as a store of value, and may not serve its other functions (unit of account, medium of exchange).
- People may conduct transactions with barter or a stable foreign currency.

What causes hyperinflation?

- Hyperinflation is caused by excessive money supply growth:
- When the central bank prints money, the price level rises.
- If it prints money rapidly enough, the result is hyperinflation.

A few examples of hyperinflation

	money growth (%)	*inflation (%)*
Israel, 1983-85	295	275
Poland, 1989-90	344	400
Brazil, 1987-94	1350	1323
Argentina, 1988-90	1264	1912
Peru, 1988-90	2974	3849
Nicaragua, 1987-91	4991	5261
Bolivia, 1984-85	4208	6515

Why governments create hyperinflation

- When a government cannot raise taxes or sell bonds,
- it must finance spending increases by printing money.
- In theory, the solution to hyperinflation is simple: stop printing money.
- In the real world, this requires drastic and painful fiscal restraint.

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

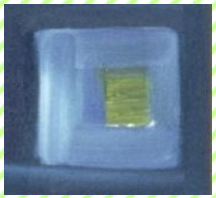
Nominal variables: Measured in money units, *e.g.,*

- 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.

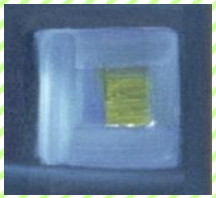


Chapter Summary

Money

- the stock of assets used for transactions
- serves as a medium of exchange, store of value, and unit of account.
- Commodity money has intrinsic value, fiat money does not.
- Central bank controls the money supply.

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



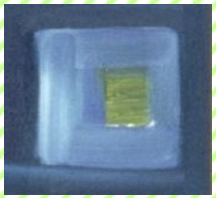
Chapter Summary

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

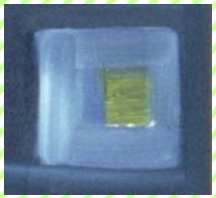
- depends only on income in the Quantity Theory
- also depends on the nominal interest rate
- if so, then changes in expected inflation affect the current price level.



Chapter Summary

Costs of inflation

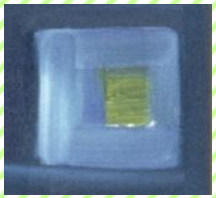
- *Expected inflation*
  shoeleather costs, menu costs,
  tax & relative price distortions,
  inconvenience of correcting figures for inflation
- *Unexpected inflation*
  all of the above plus arbitrary redistributions of wealth between debtors and creditors



Chapter Summary

Hyperinflation

- caused by rapid money supply growth when money printed to finance govt budget deficits
- stopping it requires fiscal reforms to eliminate govt's need for printing money



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.