5

MACROECONOMICS

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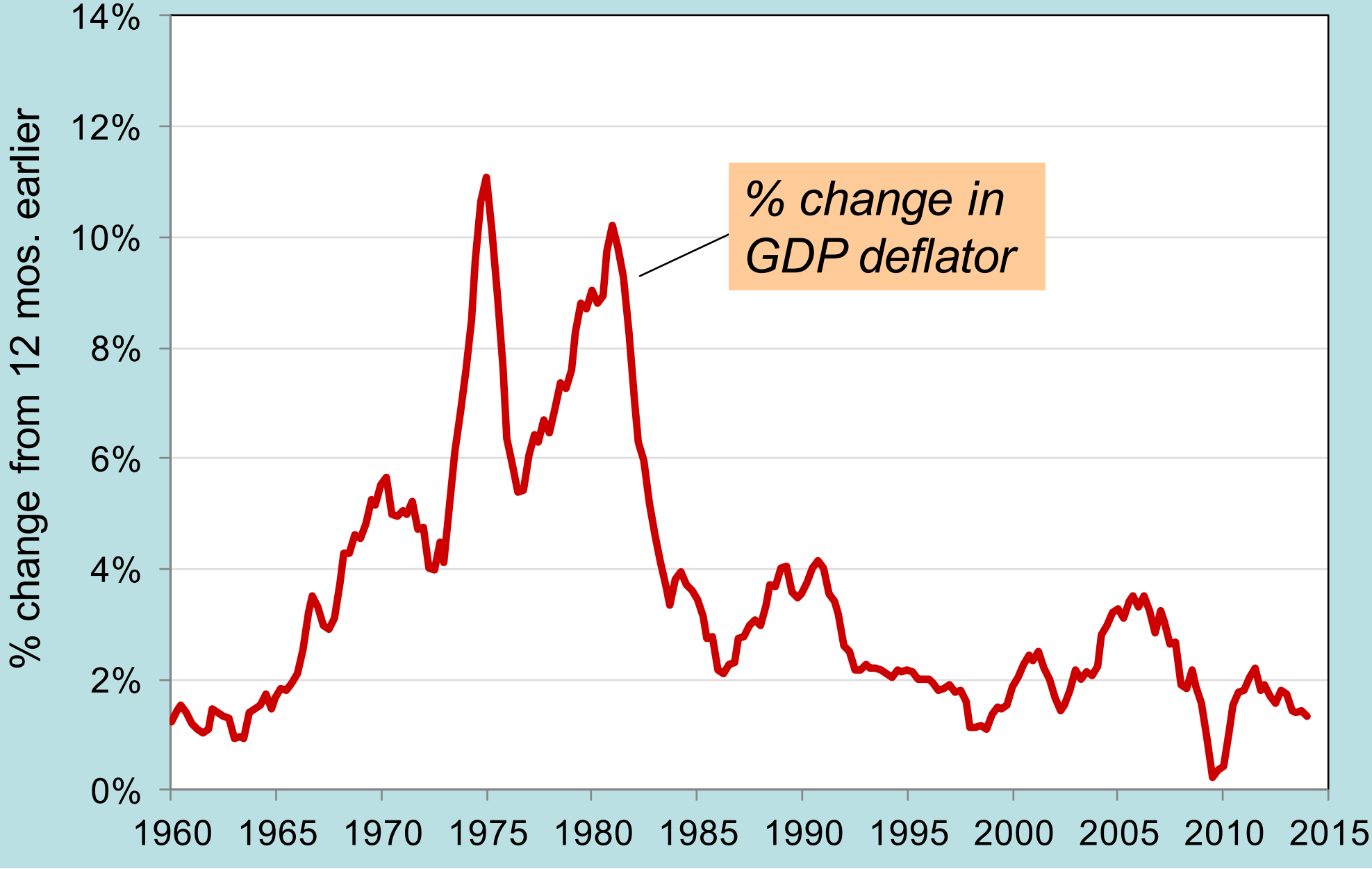
Inflation: Its Causes, Effects, and Social Costs

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

U.S. inflation and its trend, 1960-2014



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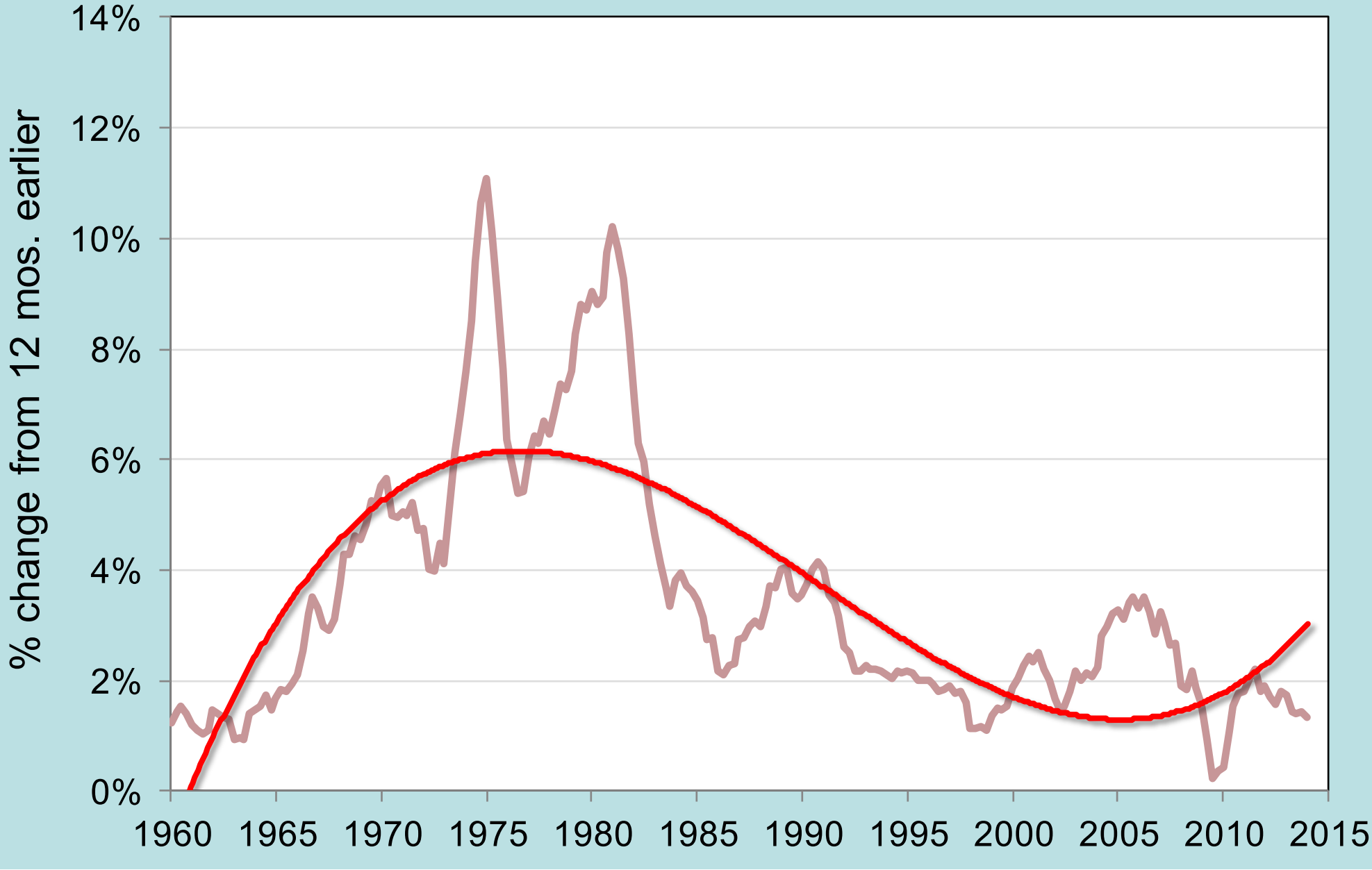


The quantity theory of money

- 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 2015,
  - $500 billion in transactions
  - money supply = $100 billion
  - The average dollar is used in five transactions in 2015
  - So, velocity = 5

Velocity *(continued)*

- This suggests the following definition:

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

where

V = velocity

T = value of all transactions

M = money supply

Velocity *(continued)*

- 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 large), money changes hands infrequently (V is small).

Back to the quantity theory of money

- Starts with quantity equation
- Assumes V is constant & exogenous: $V = \overline{V}$

Then, quantity equation becomes:

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

The quantity theory of money *(continued)*

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

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 (Chapter 3).
- The price level is P = (nominal GDP)/(real GDP).

The quantity theory of money *(continued)*

- *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 *(continued)*

π (Greek letter *pi*) denotes the inflation rate:

$$\pi = \frac{\Delta P}{P}$$

The result from the preceding slide:

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

Solve this result for π:

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

The quantity theory of money *(continued)*

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

- 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 *(continued)*

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

$\Delta Y/Y$ 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.

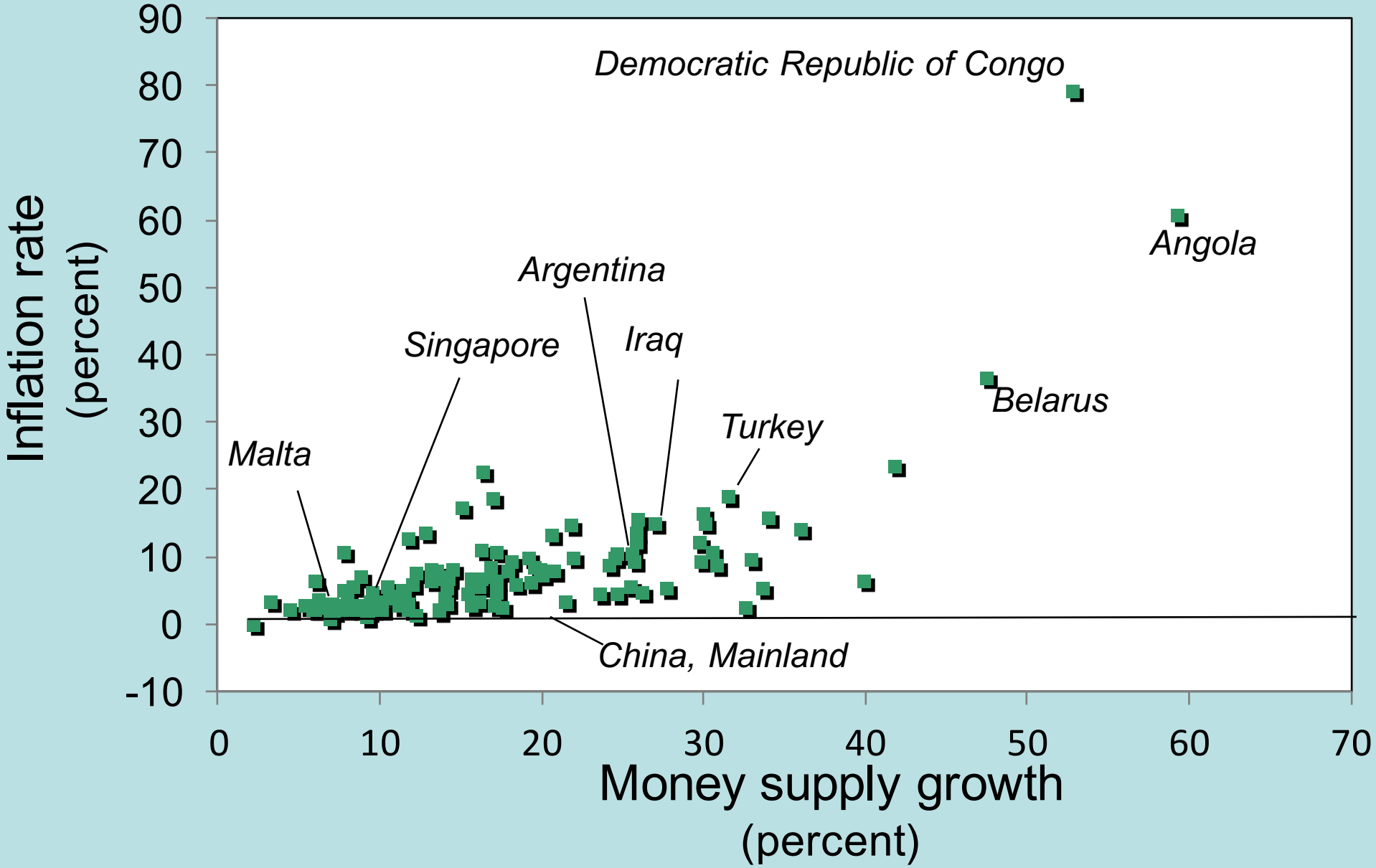
Confronting the quantity theory with data

The quantity theory of money implies:

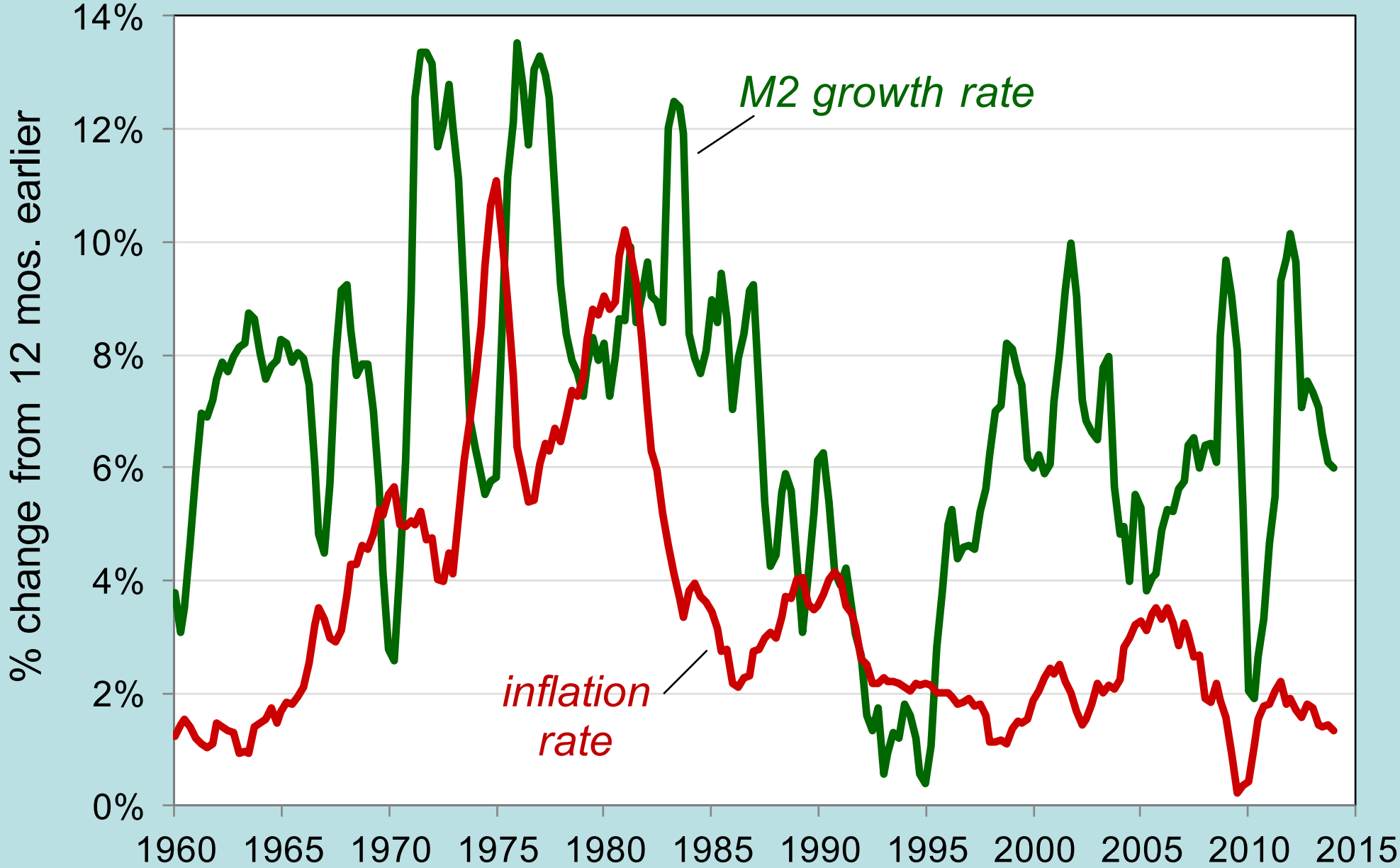
1. Countries with higher money growth rates should have higher inflation rates.
2. The long-run trend in a country's inflation rate should be similar to the long-run trend in the country's money growth rate.

Are the data consistent with these implications?

International data on inflation and money growth



U.S. inflation and money growth, 1960-2014



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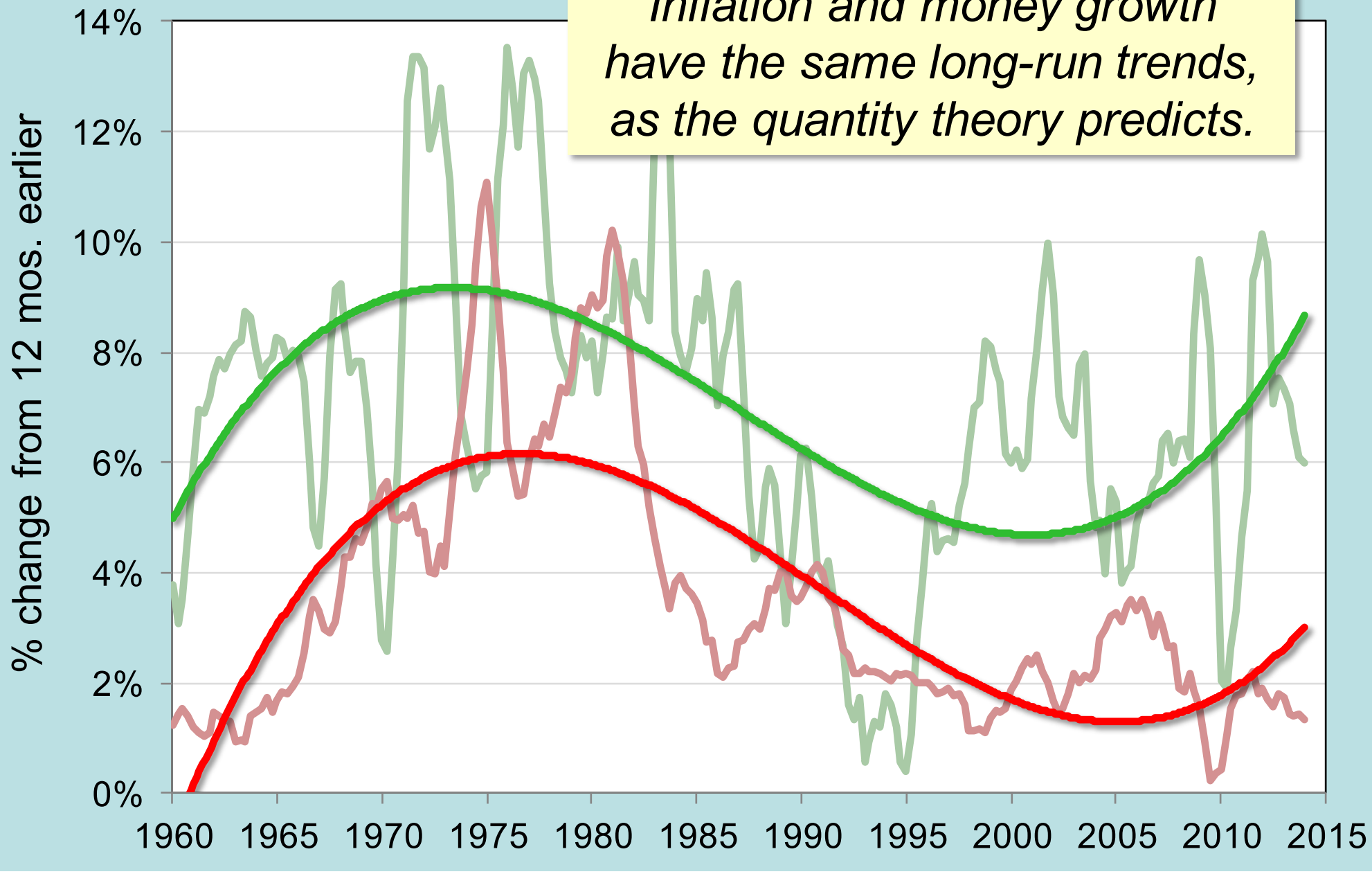


Inflation and interest rates

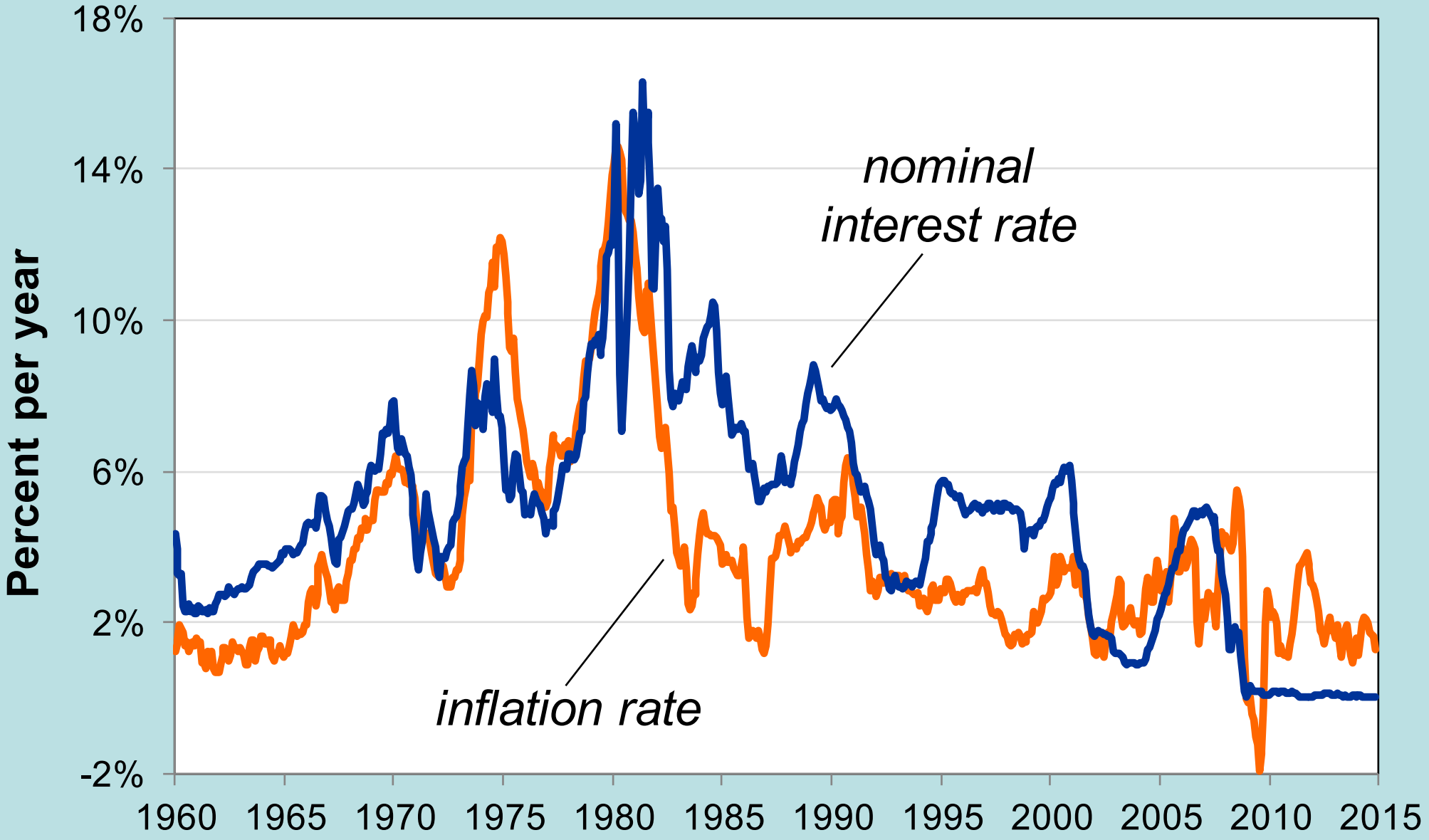
- Nominal interest rate, ***i***
  not adjusted for inflation
- Real interest rate, ***r***
  adjusted for inflation:

$$r = i - \pi$$

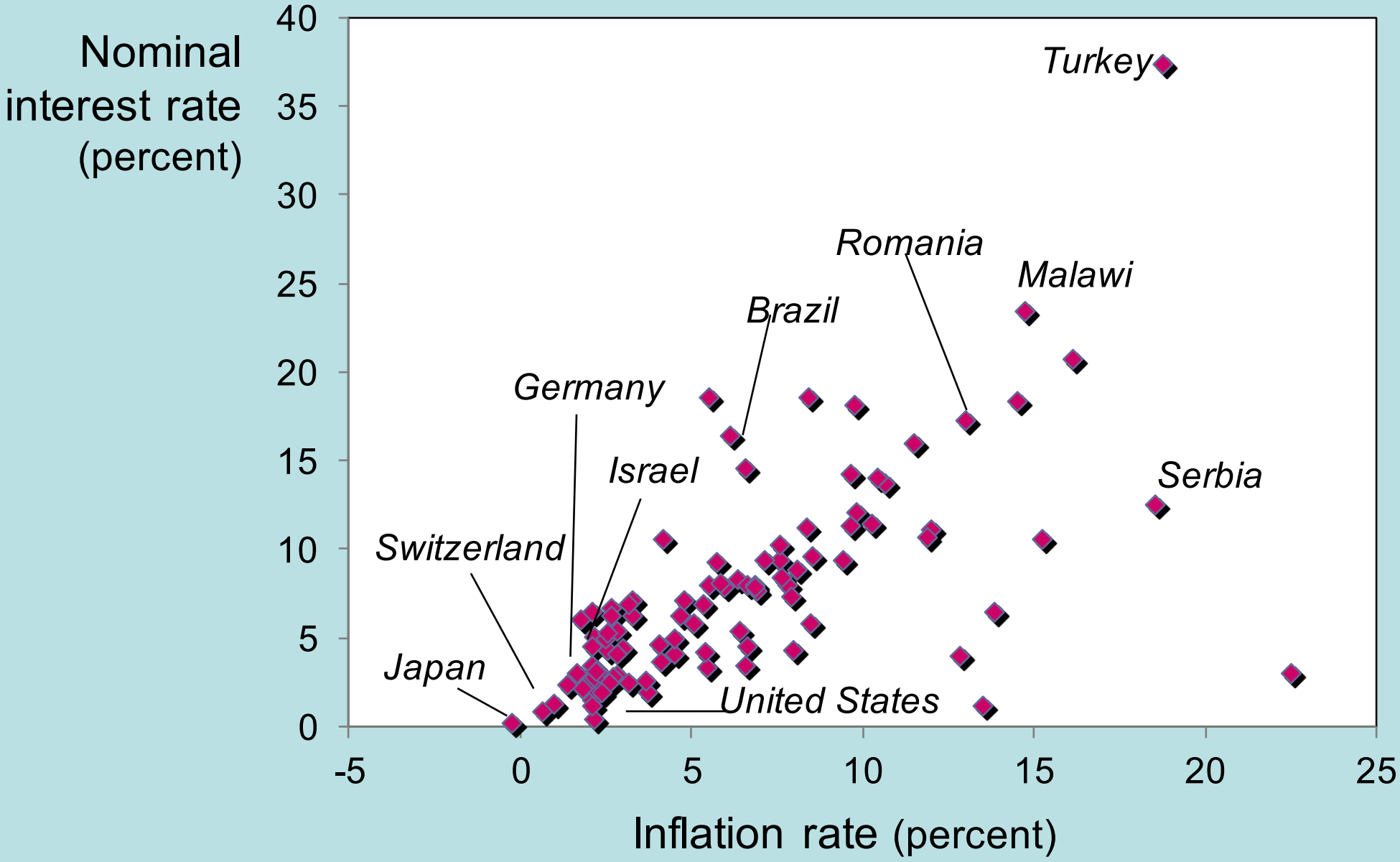
The Fisher effect

- The Fisher equation: $i = r + \pi$
- Chapter 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, 1960-2014



Inflation and nominal interest rates in 100 countries



NOW YOU TRY

Applying the theory

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
Applying the theory

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, the Fed must reduce the money growth rate by 1 percentage point per year.

Two real interest rates

Notation:

- π = actual inflation rate
  (not known until after it has occurred)
- $E\pi$ = expected inflation rate

Two real interest rates:

- $i - E\pi$ = ***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).
- So, money demand depends negatively on ***i***.

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 increases spending on g&s,

  so increases need for money

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

The money demand function

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

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 $r + E\pi$.

Equilibrium

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

The supply of real money balances

Real money demand

What determines what?

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

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

How *P* responds to ΔM

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

- For given values of ***r***, ***Y***, and $E\pi$,
  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 $E\pi = \pi$ on average.
- In the short run, $E\pi$ may change when people get new information.
- *E.g.*: The Fed announces it will increase ***M*** next year. People will expect next year's ***P*** to be higher, so $E\pi$ rises.
- This affects ***P*** now, even though ***M*** hasn't changed yet...

How *P* responds to $\Delta E\pi$

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

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

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

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

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

to re-establish eq'm

The Cagan Model (appendix)

$$m_t - p_t = -\gamma(Ep_{t+1} - p_t), \qquad (A8)$$

$$p_t = \left(\frac{1}{1+\gamma}\right)\left[m_t + \left(\frac{\gamma}{1+\gamma}\right)Em_{t+1} + \left(\frac{\gamma}{1+\gamma}\right)^2 Em_{t+2} + \left(\frac{\gamma}{1+\gamma}\right)^3 Em_{t+3} + \ldots\right]. \qquad (A9)$$

NOW YOU TRY
Discussion Question

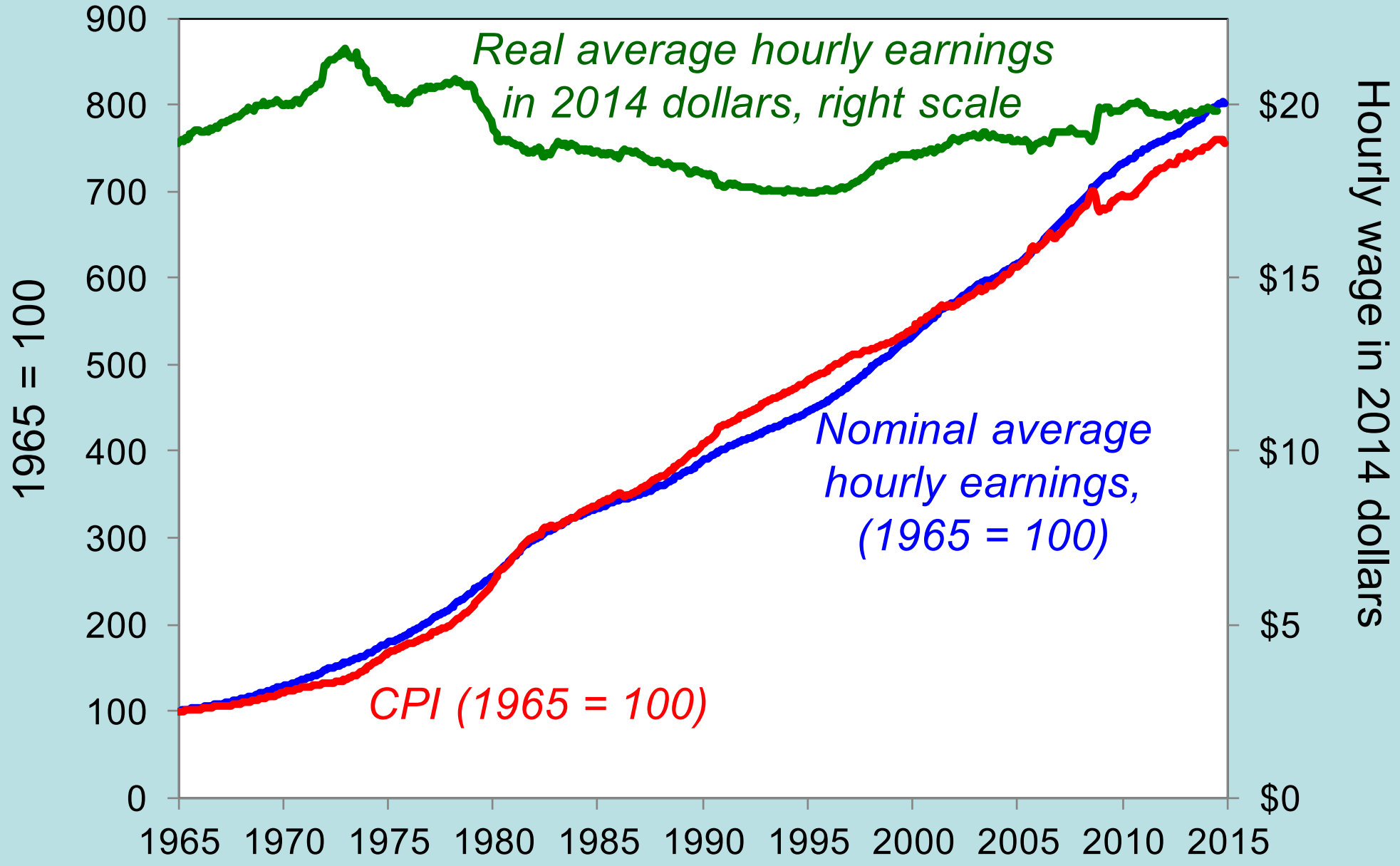
Why is inflation bad?

- 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.
- (Chapter 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 . . .

The CPI and average hourly earnings, 1965–2015



The classical view of inflation

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

Then, why 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

- Definition: the costs and inconveniences of reducing money balances to avoid the inflation tax.
- If π increases, ***i*** increases (why?), so people reduce their 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

- Definition: 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 Apple stock
- Dec 31: you sell the stock for $11,000, so your nominal capital gain is $1,000 (10%).
- Suppose π = 10% during the year. Your real capital gain is $0.
- Yet, you must pay taxes on your $1,000 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 $E\pi$.
- If π turns out different from $E\pi$, then some gain at others' expense.
  Example: borrowers & lenders
  - If $\pi > E\pi$, then $(i - \pi) < (i - E\pi)$
    and purchasing power is transferred from lenders to borrowers.
  - If $\pi < E\pi$, 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 $E\pi$ more often,
  and the differences tend to be larger,
  though not systematically positive or negative.

- So, arbitrary redistributions of wealth more likely.

- This increases 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.

Seigniorage

- To spend more without raising taxes or selling bonds, the government can print money.
- The "revenue" raised from printing money is called **seigniorage**. (pronounced SEEN-your-idge).
- The **inflation tax**: Printing money to raise revenue causes inflation. Inflation is like a tax on people who hold money.

Hyperinflation

- Common definition: $\pi \geq 50\%$ 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

country	***period***	***CPI Inflation*** *% per year*	***M2 Growth*** *% per year*
Israel	1983-85	338%	305%
Brazil	1987-94	1,256	1,451
Bolivia	1983-86	1,818	1,727
Ukraine	1992-94	2,089	1,029
Argentina	1988-90	2,671	1,583
Dem. Republic of Congo / Zaire	1990-96	3,039	2,373
Angola	1995-96	4,145	4,106
Peru	1988-90	5,050	3,517
Zimbabwe	2005-07	5,316	9,914

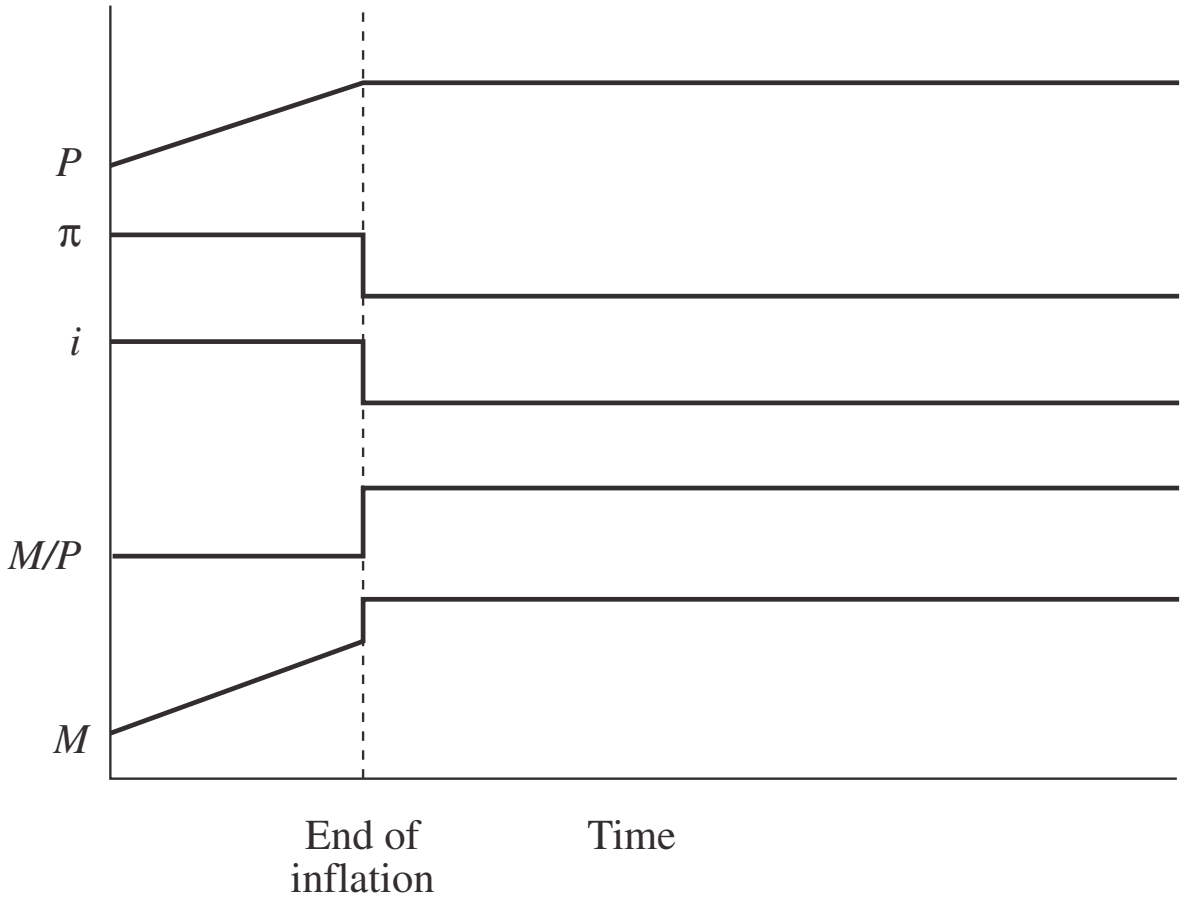
Why governments create hyperinflation

- 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.

Ending Hyperinflation

Time Paths of Variables:

Figure 1



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

- Recall: Real variables were explained in Chapter 3, nominal ones in Chapter 5.
- ***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

- Velocity: the ratio of nominal expenditure to money supply, the rate at which money changes hands
- Quantity theory of money
  - assumes velocity is constant
  - concludes that the money growth rate determines the inflation rate
  - applies in the long run
  - consistent with cross-country and time-series data

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 with 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.