Inflation: Its Causes, Effects, and Social Costs

Presentation Slides

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Macroeconomics

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IN THIS CHAPTER, YOU WILL LEARN:

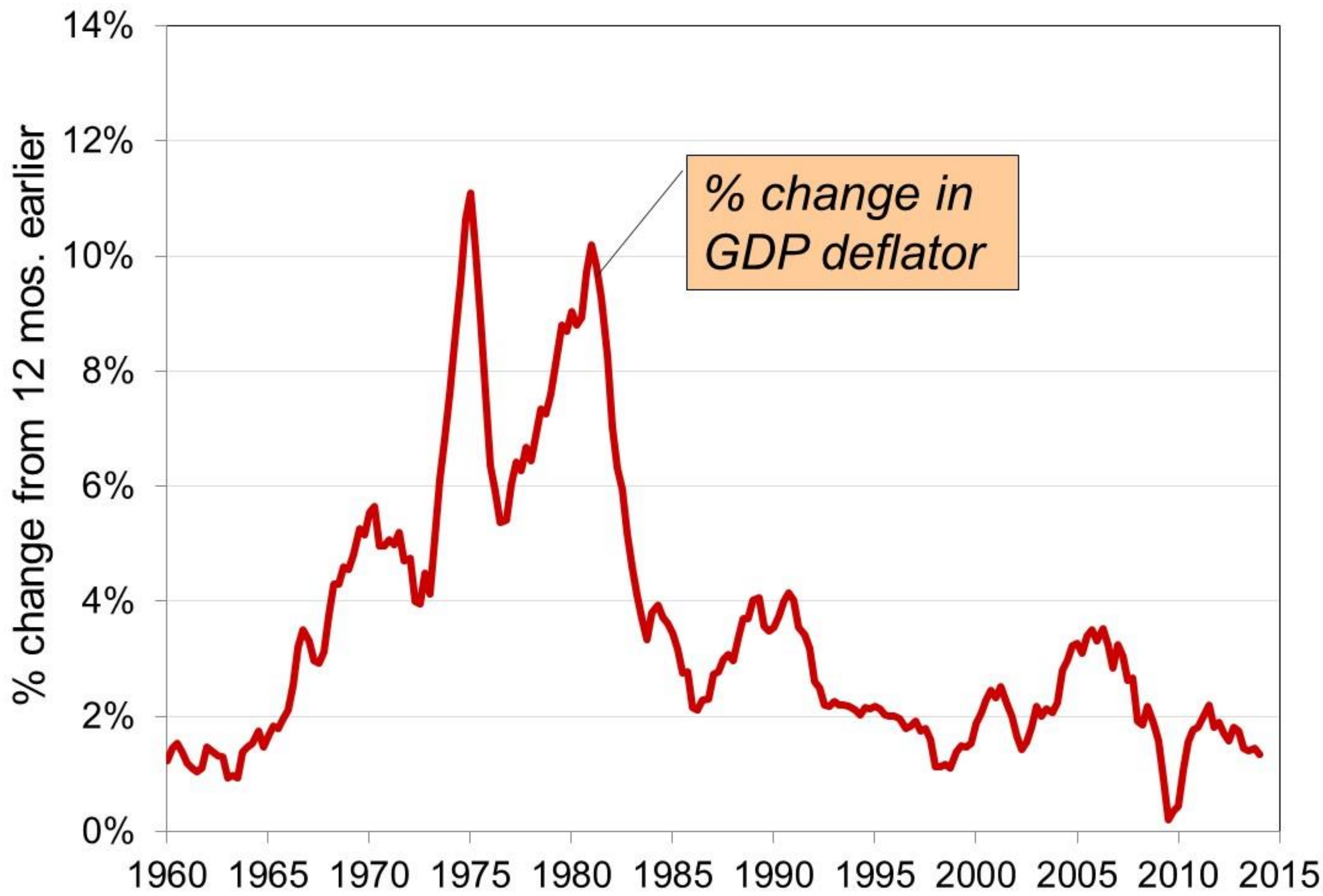
The classical theory of inflation

- Causes
- Effects
- social costs

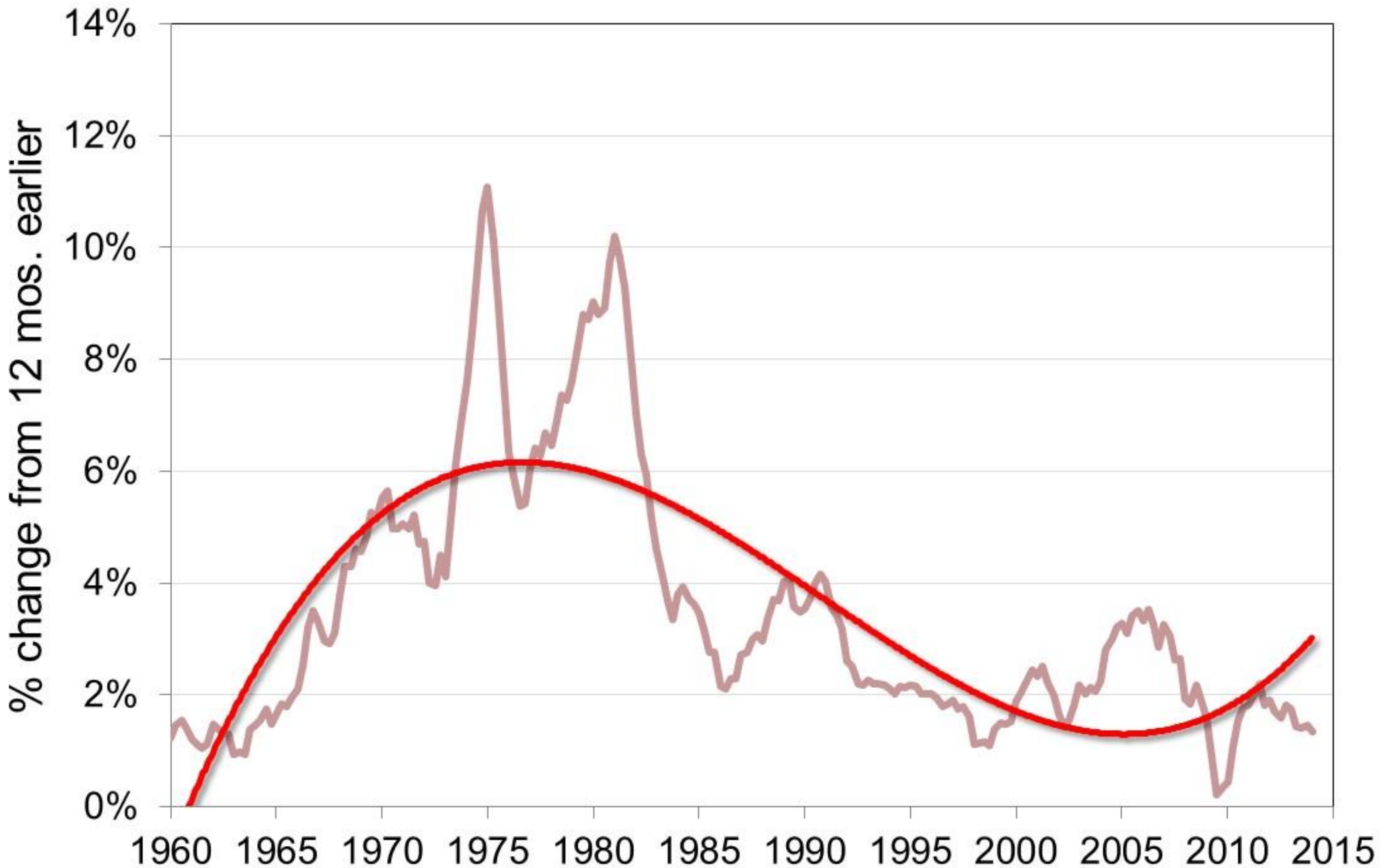
"Classical"—assumes prices are flexible and markets clear

Applies to the long run

U.S. inflation and its trend, 1960–2014, part 1



U.S. inflation and its trend, 1960–2014, part 2



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, part 1

- 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 2018,
    - $500 billion in transactions
    - money supply = $100 billion
    - The average dollar is used in five transactions in 2018
    - So, velocity = 5

Velocity, part 2

This suggests the following definition:

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

where

V = velocity

T = value of all transactions

M = money supply

Velocity, part 3

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**

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

follows from the preceding definition of velocity.

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

Money demand and the quantity equation, part 1

- ***M*/*P*** = **real money balances**, the purchasing power of the money supply.

- A simple money demand function:

  $(\boldsymbol{M/P})^d = \boldsymbol{k\,Y}$

where

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

(***k*** is exogenous)

Money demand and the quantity equation, part 2

- Money demand: $(\boldsymbol{M/P})^d = \boldsymbol{k\,Y}$
- Quantity equation: $\boldsymbol{M} \times \boldsymbol{V} = \boldsymbol{P} \times \boldsymbol{Y}$
- The connection between them: $\boldsymbol{k} = 1/\boldsymbol{V}$
- When people hold lots of money relative to their incomes ($\boldsymbol{k}$ is large), money changes hands infrequently ($\boldsymbol{V}$ is small).

Back to the quantity theory of money

Starts with quantity equation

Assumes $\boldsymbol{V}$ is constant and exogenous: $\boldsymbol{V} = \overline{\boldsymbol{V}}$

Then, the quantity equation becomes:

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

The quantity theory of money, part 1

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

How the price level is determined:

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

The quantity theory of money, part 2

- *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, part 3

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:

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

The quantity theory of money, part 4

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

- 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, part 5

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

$\Delta Y/Y$ 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 relationship between changes in the money growth rate and changes in the inflation rate.

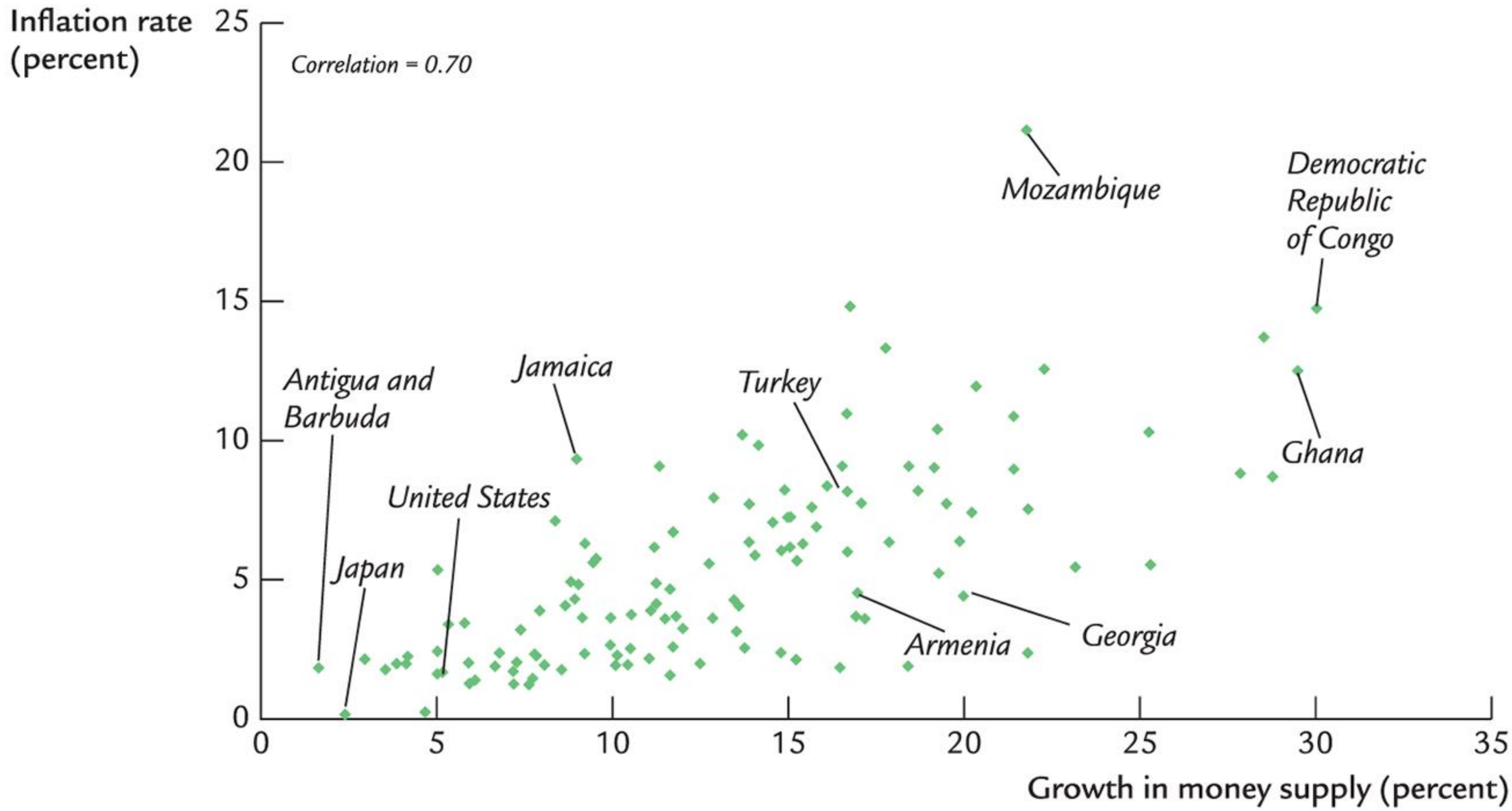
Confronting the quantity theory with data

The quantity theory of money implies:

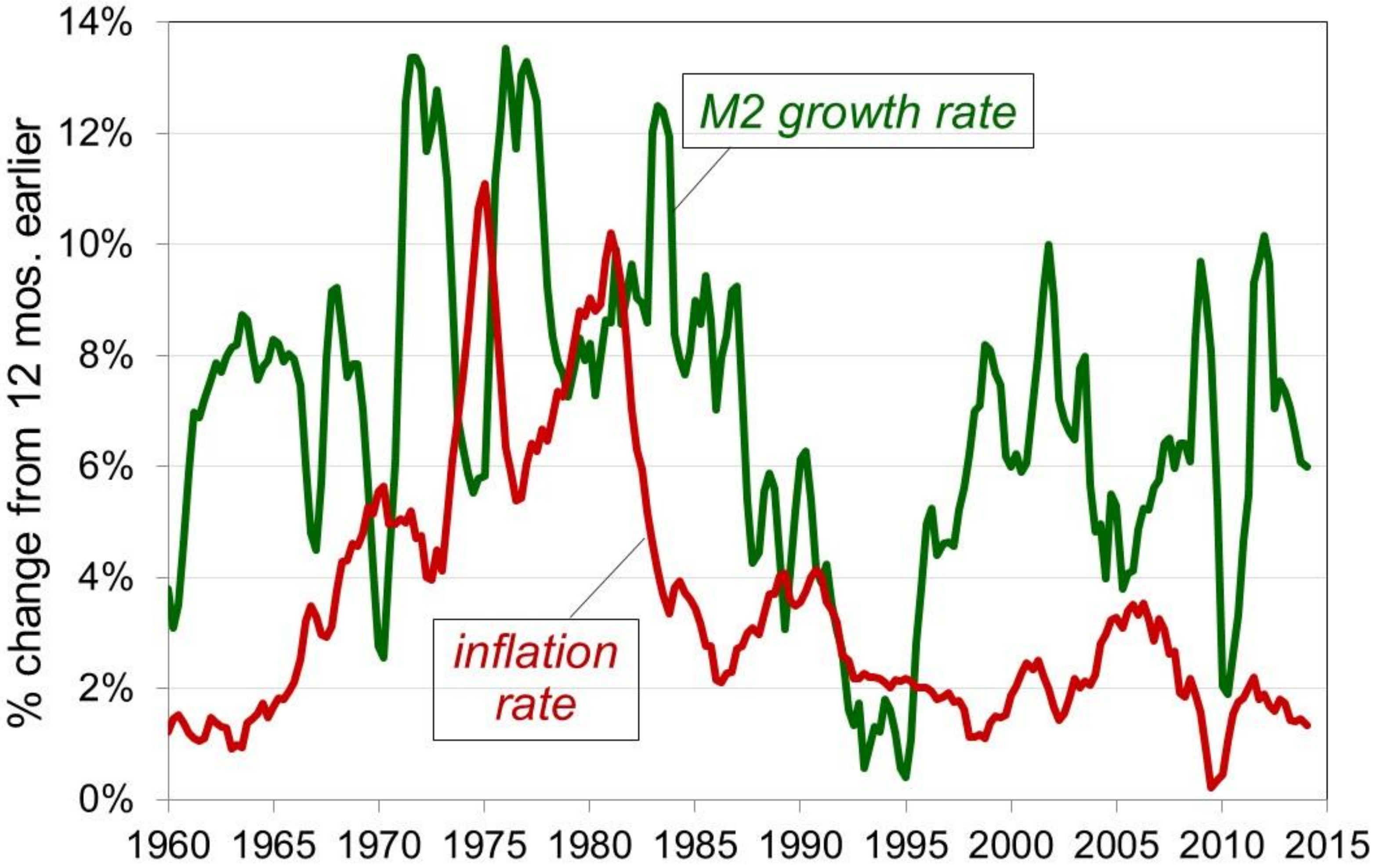
1. Countries with higher money growth rates should have higher inflation rates.
2. The long-run trend in a country's inflation rate should be similar to the long-run trend in the country's money growth rate.

Are the data consistent with these implications?

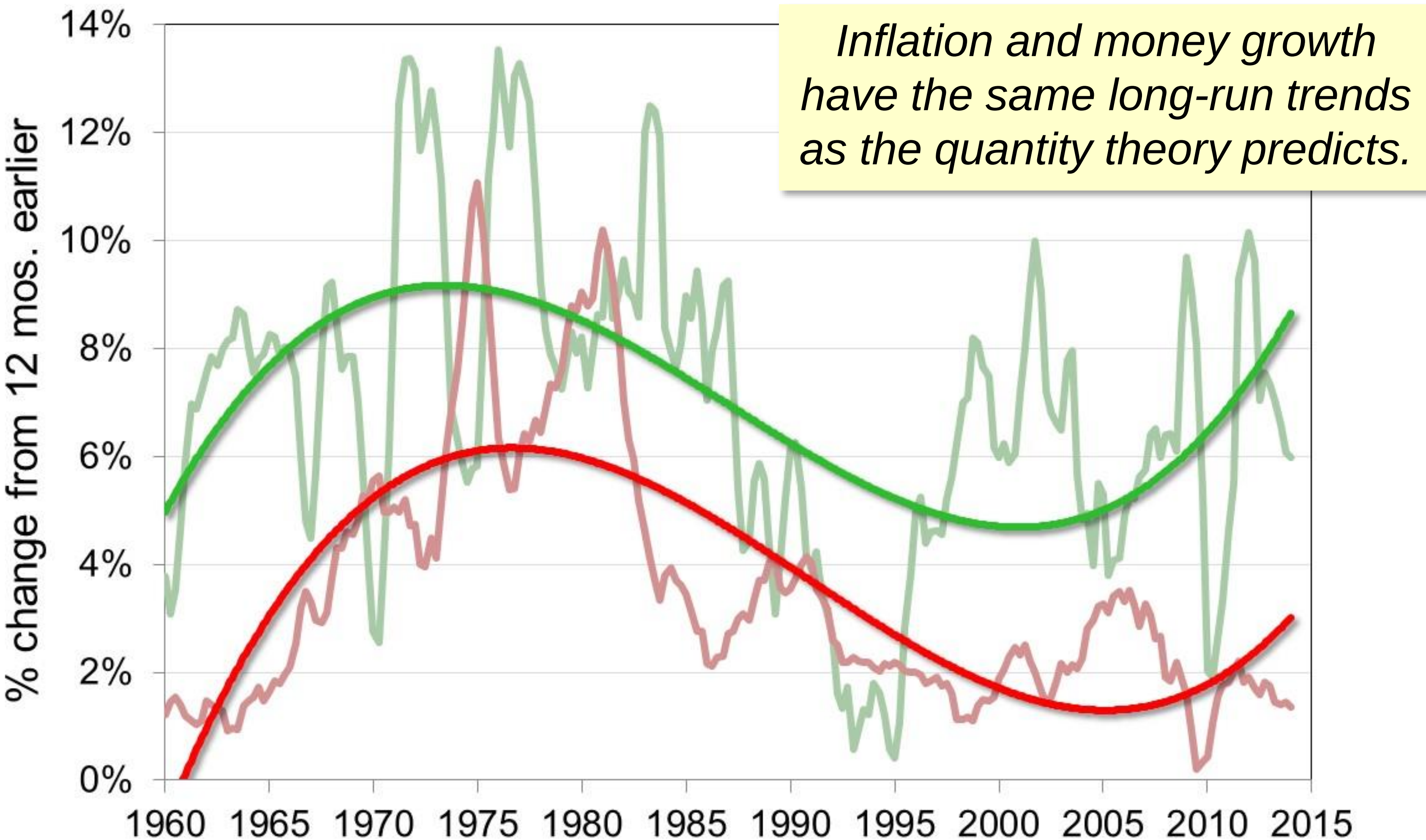
International data on inflation and money growth



U.S. inflation and money growth, 1960–2014, part 1



U.S. inflation and money growth, 1960–2014, part 2



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.

Inflation and interest rates

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

$$\boldsymbol{r} = \boldsymbol{i} - \pi$$

The Fisher effect

The Fisher equation: $i = r + \pi$

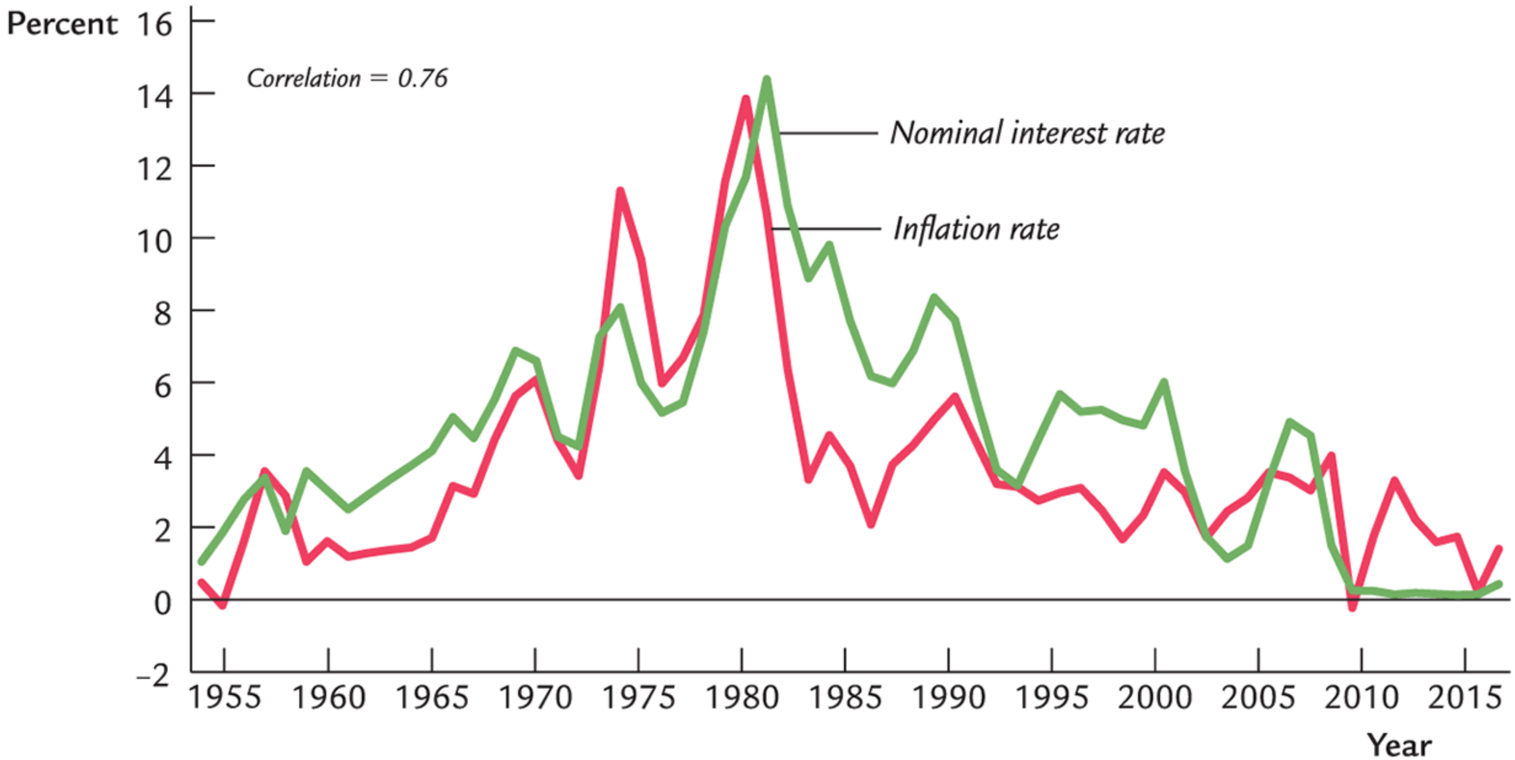
Chapter 3: $S = I$ determines r .

Hence, an increase in π causes an equal increase in i.

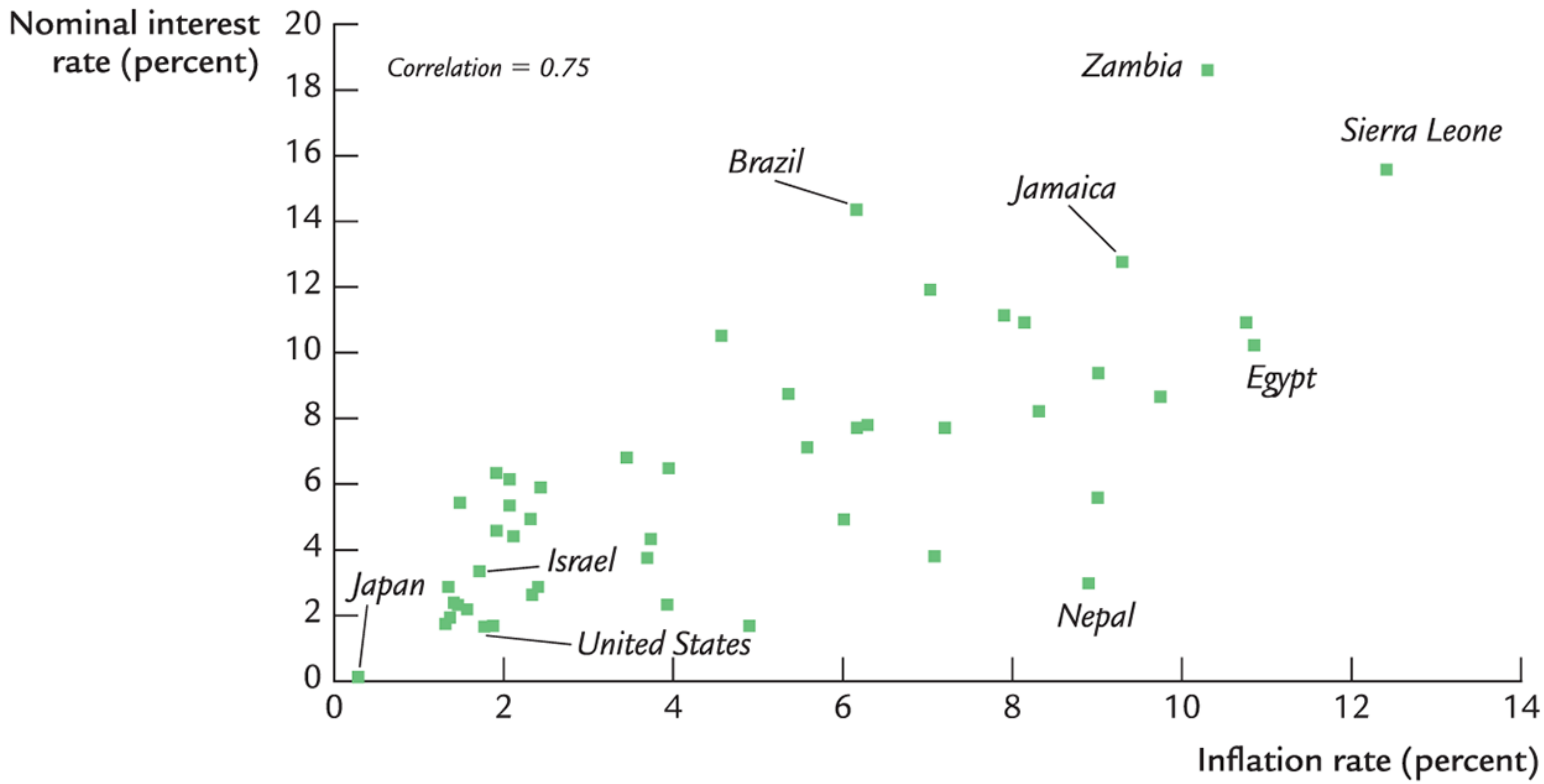
This one-for-one relationship is called the **Fisher effect**.

A change in money growth or inflation do not affect the real interest rate.

U.S. inflation and nominal interest rates, 1955-2015



Inflation and nominal interest rates in 48 countries



Mankiw, *Macroeconomics*, 10e, © 2019 Worth Publishers

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 Δ***i***.

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?

NOW YOU TRY

Applying the theory, 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 $\boldsymbol{i} = \boldsymbol{r} + \pi = 4 + 3 = 7$.

b. $\Delta \boldsymbol{i} = 2$, the 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*** – π = ***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, part 1

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

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

- negatively on ***I (nominal interest rate)***

  i is the opposite cost of holding money

- positively on ***Y (income)***

  higher ***Y*** increases spending on g&s

  so increases the need for money

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

The money demand function, part 2

$$
\begin{aligned}
(\boldsymbol{M/P})^{\mathrm{d}} &= \boldsymbol{L}(\boldsymbol{i}, \boldsymbol{Y}) \\
&= \boldsymbol{L}(\boldsymbol{r} + E\pi, \boldsymbol{Y})
\end{aligned}
$$

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 $\boldsymbol{r} + E\pi$.

Equilibrium

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

The supply of real money balances

Real money demand

What determines what?

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

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

P adjusts to ensure $\overline{Y} = F(\overline{K}, \overline{L})$

How *P* responds to Δ*M*

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

- 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.
- *Example*: The Fed announces it will increase $\boldsymbol{M}$ next year. People will expect next year's $\boldsymbol{P}$ to be higher, so $E\pi$ rises.
- This affects $\boldsymbol{P}$ now, even though $\boldsymbol{M}$ hasn't changed yet...

How P responds to $\Delta E\pi$

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

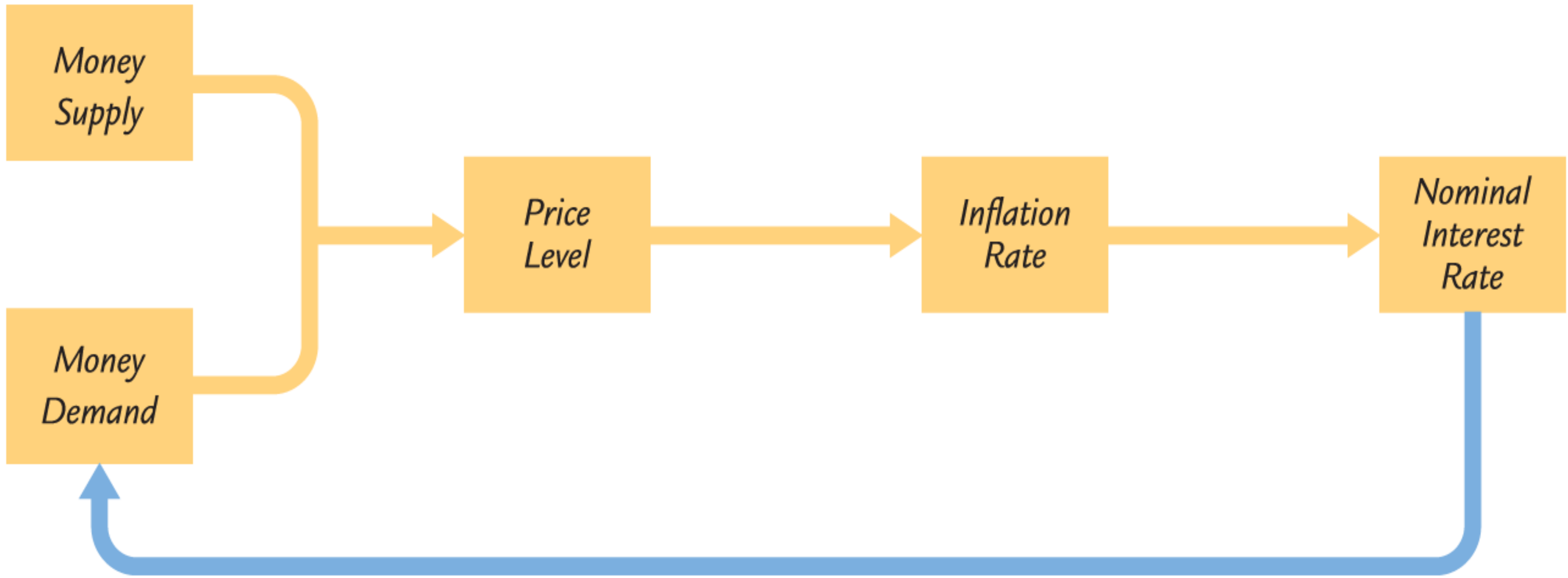
For given values of ***r***, ***Y***, and ***M***,

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

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

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

to re-establish eq'm



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?

NOW YOU TRY
Discussion question

Why is inflation bad?

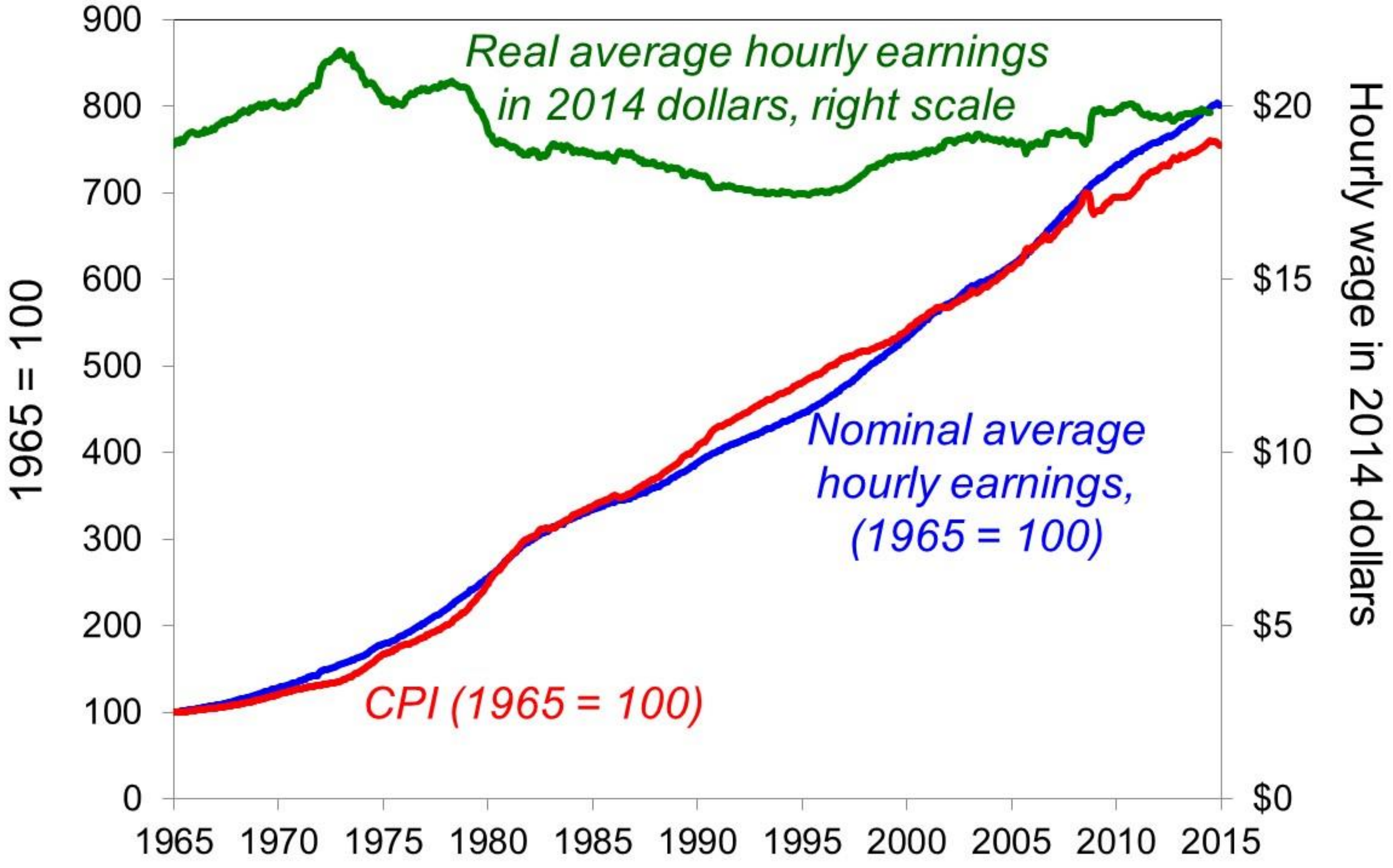
What costs does inflation impose on society?

- List all the costs 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 social costs of inflation

…fall into two categories:

1. costs when inflation is expected
2. costs when inflation is different from what 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.
- The 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 and mailing out catalogs
  - time spent trying to decide on what the new prices should be
- The higher is inflation, the more frequently firms must change their prices and incur these costs.

The costs of expected inflation: 2. Menu costs

CHACHOS
Cruz on in 24 hours a day!
6006 Westheimer
Houston Texas 77057
713-975-9899

Order [redacted]

Host: [redacted] 07/18/2008
Order [redacted]
REPRINT# [redacted]

Beef Fajita Plate - Stkhs	9.99
Small Sprite	1.49
Pastor Tacos Plate	8.99
PHShred Beef Nachos 1/2 Yellow Cheese	5.99
Sub Total	26.46
Tax	2.35
7.5% Inflation Srchg	1.98
Order Total	30.79
[redacted]	30.79

Tip :

TOTAL :

TOTAL :

SIGNATURE :

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

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.

The costs of *unexpected* inflation: Arbitrary redistribution of purchasing power

- Many long-term contracts are not indexed but are based on $E\pi$.
- If π turns out to be different from $E\pi$, then some gain at others' expense.

  Example: borrowers and lenders

  - If $\pi > E\pi$, then $(\boldsymbol{i} - \pi) < (\boldsymbol{i} - E\pi)$ 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 are 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.

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 it 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.

The classical dichotomy, part 1

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

The classical dichotomy, part 2

***Nominal variables**: measured in money units—for example:*

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

The classical dichotomy, part 3

- 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***: idea that changes in the money supply do not affect real variables.
- In the real world, money is approximately neutral in the long run.

CHAPTER SUMMARY, PART 1

- 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, PART 2

- Nominal interest rate
  - equals real interest rate + inflation rate
  - the opportunity 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, PART 3

Costs of inflation

- *Expected inflation*
  shoeleather costs, menu costs, tax and 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, PART 4

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

CHAPTER SUMMARY, PART 5

- Classical dichotomy
  - In classical theory, money is neutral—does not affect real variables.
  - So, we can study how real variables are determined without 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.